

Nebraska Swimming Pool Operator Clinic



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Clinic Outline

- **Healthy Swimming**
- **Rules and Regulations**
- **Circulation and Filtration**
- **Water Balance**
- **Water Treatment**
- **Water Testing Methods**
- **Spas**



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Healthy Swimming

Chlorine Enemies

- Body discharges
 - Mucous, saliva, sweat, urine
- Environmental
 - Street and work place dust, pollen, air pollutants, animals droppings, insects



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Healthy Swimming

Chlorine Enemies

- Fecal residue
 - Body grime and dead skin
 - Public bathers
 - Body lotions and creams
 - Personal care products
-
- Shower **WITH SOAP** before entering the pool!



Healthy Swimming

- Common waterborne germs can cause
 - Eye infection
 - Conjunctivitis (pinkeye)
 - Ear infections
 - Skin infections
 - Respiratory infections



Source: [Tanalai at en.wikipedia](#)

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Healthy Swimming

Watch bathers for:

- Sore or inflamed eyes
- Colds
- Nasal or ear discharge
- Boils, or other obvious skin or body infections, or cuts
- **EXCLUDE THEM FROM THE POOL**



Photo Credit: Gregory Moran, M.D.

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Healthy Swimming

Emergence of new germs

- Serious illness in healthy people
- Life threatening for high risk population
 - Elderly
 - People in poor health
 - Pregnant women
 - Young children

- MRSA – Methicillin Resistant Staphylococcus Aureus
- *Cryptosporidium*
- *Shigella*
- *E. coli*



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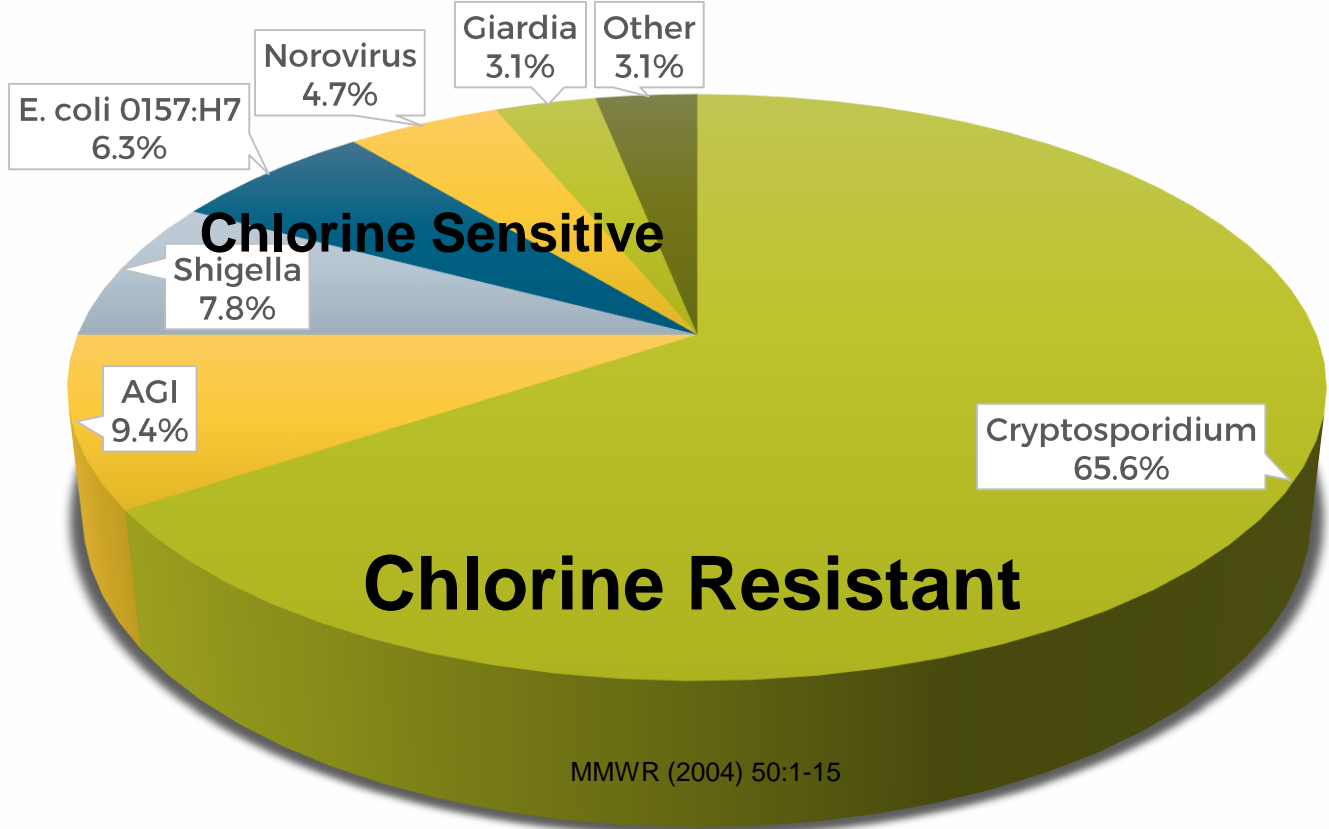
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Healthy Swimming

U.S. Waterborne Disease Outbreaks, 1993-2002



Healthy Swimming

Germ Inactivation Time

1 ppm chlorine at 7.5 pH

E. coli, bacteria

Less than 1 minute

Hepatitis A, virus

About 16 minutes

Cryptosporidium, parasite

15,300 minutes or 10.6 days

"Fecal Incident Response Recommendations for Pool Staff" www.cdc.gov/healthyswimming (August 1, 2008)

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Healthy Swimming

State of the pools/spas: Surveillance data

Highest percentage of violation

Greatest risk of contamination



Source: www.cdc.gov/healthswimming/who.htm

Wading/Kiddy Pools

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Healthy Swimming

Adding it all up

Chlorine resistant germs

+

Poor pool maintenance



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Healthy Swimming

Adding it all up

Chlorine resistant germs

+

Poor pool maintenance

+

Young people with diarrhea

+

Bathers swallowing pool water



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Healthy Swimming

Adding it all up

Chlorine resistant germs

+

Poor pool maintenance

+

Young people with diarrhea

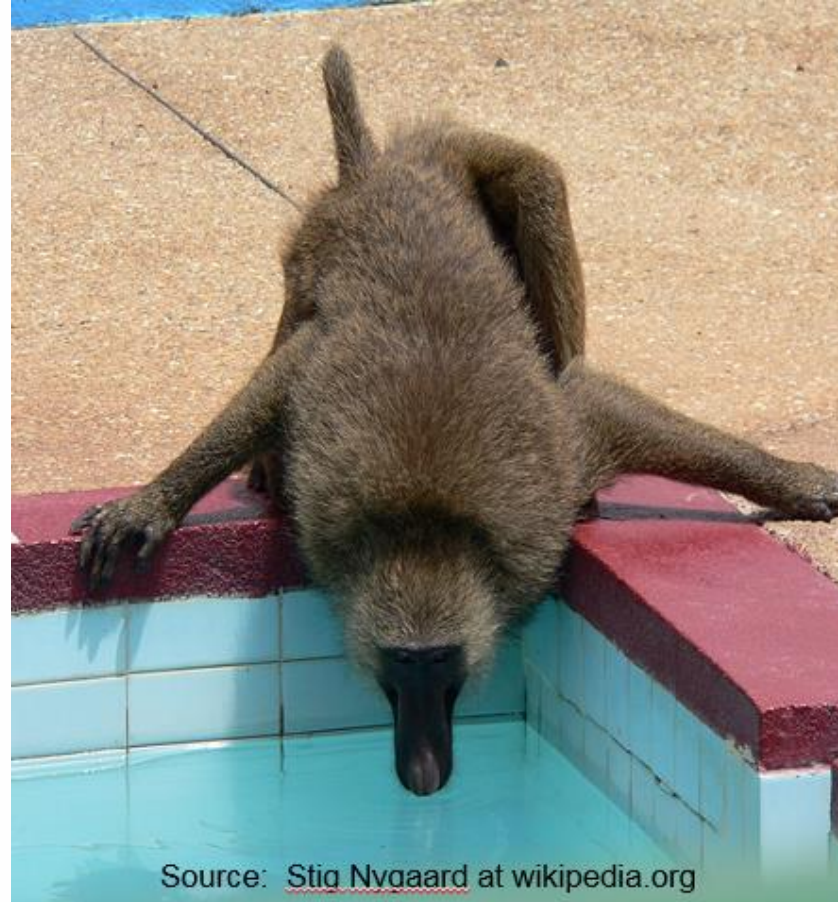
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Bathers swallowing pool water

=

Increased Risk of Outbreaks

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Healthy Swimming

Adding it all up

Eliminate/reduce risk

Don't Drink the Pool Water!



ClipArt

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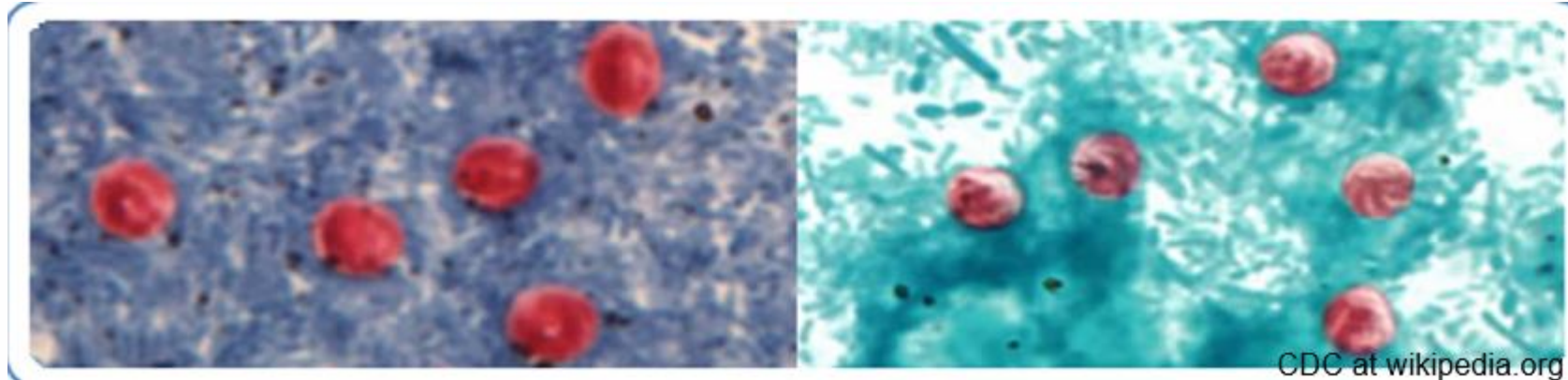
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Healthy Swimming

Infectious Doses

	<u>Healthy Adult/Toddler</u>	
• <i>Salmonella</i>	1000	100
• <i>Shigella</i> and <i>E. coli</i>	100	10
• <i>Cryptosporidium</i>	10	1



Healthy Swimming

One **diarrhea** accident can release large amounts of contaminated material into a pool or spa....

AND MILLIONS OF DANGEROUS GERMS!

www.cdc.gov/healthyswimming



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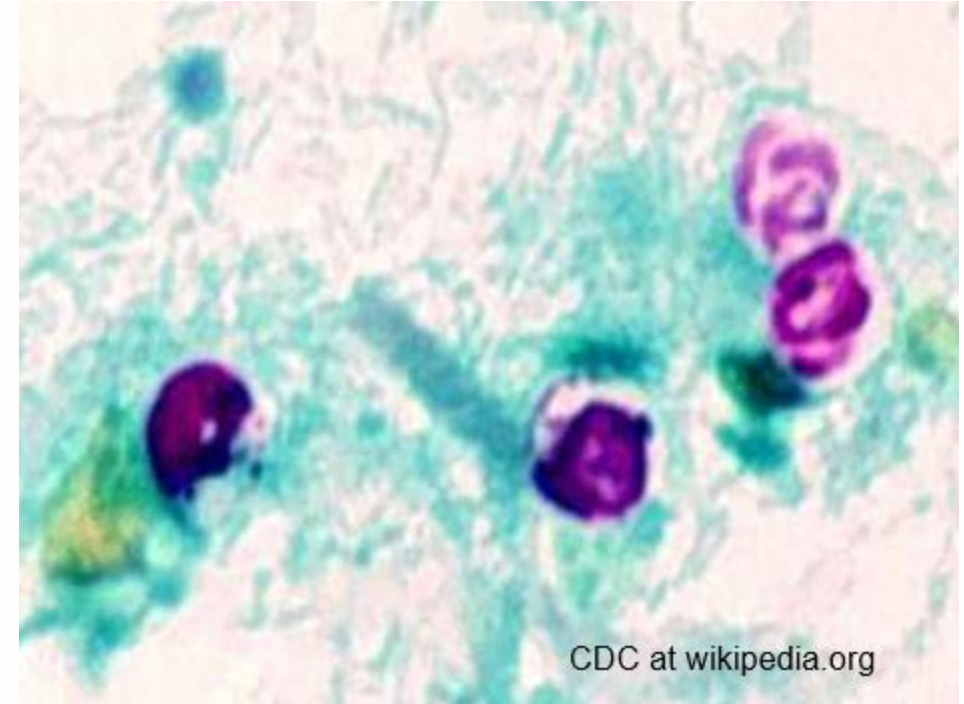
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Healthy Swimming

Cryptosporidiosis Outbreak

- Nebraska, 2000
 - Over 220 potential cases
 - Age range 2 months to 77 years
- **18% continued swimming while ill**

MMWR (2001) 50: 460-610



CDC at wikipedia.org

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Healthy Swimming

- Every pool or spa needs an established procedure when fecal accidents occur
- CDC Guidelines



Should you treat a formed fecal accident as if it contains *Cryptosporidium*?



Healthy Swimming

- Volunteers collected 300 samples from fecal accidents involving **formed** stools at water parks and pools
- None tested positive for Crypto
 - “Fecal Incident Response Recommendations for Pool Staff” (August 1, 2008) www.cdc.gov/healthyswimming
- Remember...a **diarrheal** fecal accident is a higher risk than a formed stool

Healthy Swimming

Fecal accident response (formed stool)*

- Direct everyone to leave the pool
- Remove as much fecal material as possible
- Ensure chlorine is at least 2 ppm and pH 7.2-7.5
- Maintain chlorine at 2 ppm for at least 25 minutes

* CDC recommendations (www.cdc.gov/healthyswimming)

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Healthy Swimming

Non-stabilized Pool

Fecal accident response (diarrheal stool)*

- Direct everyone to leave the pool, close pool
- Remove as much fecal material as possible
- Raise chlorine to 20 ppm and maintain pH 7.2-7.5
- Maintain chlorine at 20 ppm for 13 hours**
- Backwash filter

- Return chlorine to normal operating range

* CDC recommendations
(www.cdc.gov/healthyswimming)

** Or any combination of chlorine and time to meet a CT of 15300

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Healthy Swimming

Stabilized Pool (cyanuric acid) 1-15 ppm

Fecal accident response (diarrheal stool)*

- Direct everyone to leave the pool, close pool
- Remove as much fecal material as possible
- Maintain pH of 7.5 or less**

- Maintain chlorine:
 - 20 ppm** for 28 hours** or
 - 30 ppm** for 18 hours** or
 - 40 ppm** for 8.5 hours**
- Backwash filter
- Return chlorine to normal operating range

* CDC recommendations (www.cdc.gov/healthyswimming)

** CDC revised August 2016

Healthy Swimming

Stabilized Pool (cyanuric acid) >15 ppm***

Fecal accident response (diarrheal stool)*

- Direct everyone to leave the pool, close pool
- Remove as much fecal material as possible
- Lower concentration to 1-15 ppm by draining partially and adding fresh water without chlorine stabilizer before attempting to hyperchlorinate**

- Maintain pH of 7.5 or less**
- Maintain chlorine:
 - 20 ppm** for 28 hours** or
 - 30 ppm** for 18 hours** or
 - 40 ppm** for 8.5 hours**
- Backwash filter
- Return chlorine to normal operating range

* CDC recommendations (www.cdc.gov/healthyswimming)

** CDC revised August 2016

Healthy Swimming

How should you treat a vomit accident?

Same as a Formed Stool?

Vomit accident response*

- Direct everyone to leave the pool
- Remove as much material as possible
- Ensure chlorine is at least 2 ppm and pH 7.2-7.5
- Maintain chlorine at 2 ppm for at least 25 minutes

* CDC recommendations (www.cdc.gov/healthyswimming)



www.wikipedia.org

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SIX

Steps for

Healthy Swimming

Protection Against Recreational Water Illnesses (RWIs)

RWIs are illnesses caused by germs that can contaminate water in pools. Practice these six steps to protect yourself and others from getting sick. Without your help, even the best-maintained pools can spread germs.

THREE steps for

All Swimmers

PLEASE don't swim when you have diarrhea. You can spread germs in the water and make other people sick.

PLEASE don't swallow pool water. Avoid getting water in your mouth.

PLEASE practice good hygiene. Shower with soap before swimming and wash your hands after using the toilet or changing diapers. Germs on your body end up in the water.



THREE steps for

Parents of Young Kids

PLEASE take your kids on bathroom breaks or check diapers often. Waiting to hear "I have to go" may mean that it's too late.

PLEASE change diapers in a bathroom or a diaper-changing area and not at poolside. Germs can be spread in and around the pool.

PLEASE wash your child thoroughly (especially the rear end) with soap and water before they go swimming. Invisible amounts of fecal matter can end up in the pool.



For more information visit

www.cdc.gov/healthyswimming




Rules & Regulations

<http://deq.ne.gov/NDEQProg.nsf/OnWeb/SP>

Title 178 Chapter 2, Operation and Maintenance

Title 178 Chapter 4, Design and Construction

The purpose is to prevent and reduce:

- Disease transmission
- Drowning or near-drowning
- Injuries



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Rules & Regulations

- No public pool shall operate without a permit from DHHS
 - Local permits may also be required
- Permits are valid for one year

Lincoln-Lancaster County Health Department
Environmental Public Health Division (402) 441-8040
3140 N Street Lincoln, Nebraska 68510-1514

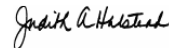
SWIMMING POOL PERMIT PERMIT # HPS00097

Establishment: STAR CITY SHORES
4375 S 33 ST
LINCOLN, NE 68516-1069

Class: Class A
Use Type: Municipal
Location: Outdoor
Issued: 4/1/2016
Expires: 3/31/2017

Permittee: CITY OF LINCOLN PARKS & REC
2740 A ST
LINCOLN, NE 68502-3199

POST IN A PROMINENT PLACE



Judith A. Halstead, MS, Health Director

Dear Pool Owner/Operator:

The above document is your new operating permit. Please post it according to requirements of the code.



Judith A. Halstead, MS
Health Director

Nebraska Department of Health and Human Services

Division of Public Health - Environmental Health Unit

Permit No.: 1969

County: YORK

Total Fee: \$100.00

2017 Swimming Pool Operating Permit

Is being issued to

York Physical Therapy & Fitness Worx Indoor Pool

For Class

F - Fitness/Health Center

on

March 17, 2017



Located At

2835 N Nebraska Ave
York, NE 68467

This permit expires
March 31, 2018

Sanitizer: Mec-O-Matic / Dolphin UD50 / Liquid (NaOCl)
Filter: Pentair / TR100
Pump: Pentair / WFE-40 / 1.0 HP
Designed Flow Rate: 70 GPM


PROGRAM MANAGER

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IMMEDIATELY NOTIFY NEBRASKA DHHS AT 402-525-6601 OF A DROWNING OR NEAR DROWNING

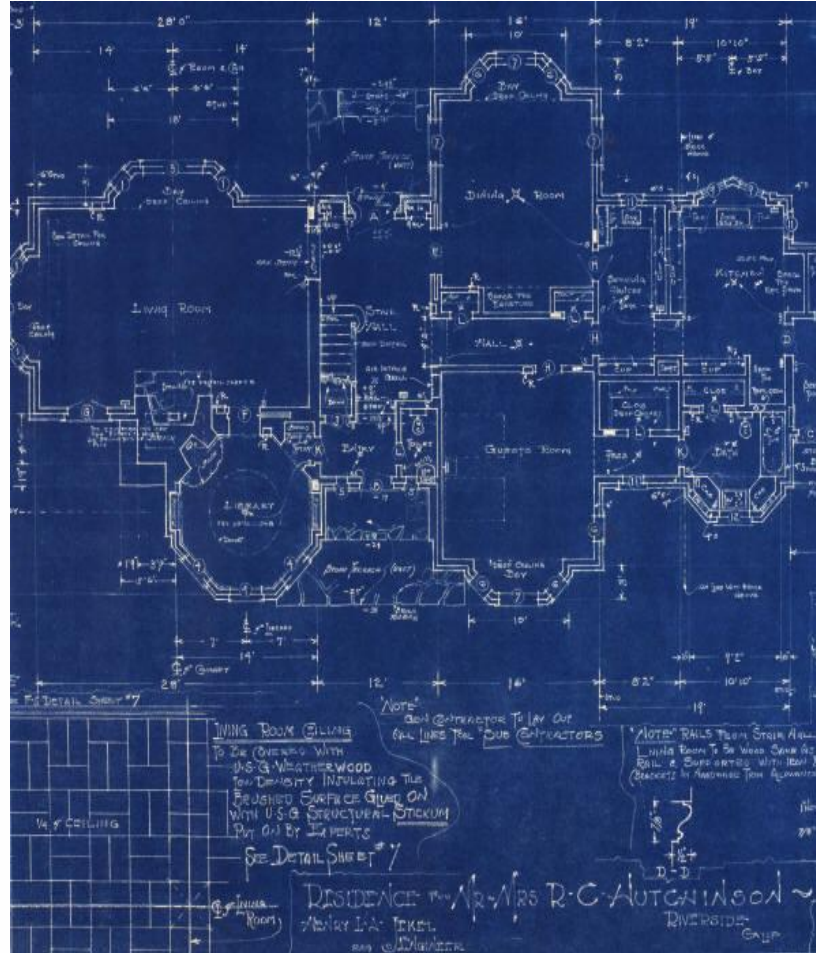
THIS PERMIT MUST BE PROMINENTLY DISPLAYED AT ALL TIMES

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Rules & Regulations

Plans and specifications for new or reconstructed pools

- Must be prepared by a Nebraska licensed engineer or architect
- Submitted to Nebraska DHHS **prior** to construction
- **Additional \$1000 for as-built plans**
- In-kind replacement **does not apply** to diving boards



Rules & Regulations

- Class A: Pools operated by political subdivisions, governmental agencies, municipalities, and any other pool operated for the purpose of public swimming
- Class B: Pools operated by hotels, motels, apartments, country clubs
- Class C: Spas
- Class D: Wading pools (stand alone)
- Class E: Spray parks
- Class F: Health clubs, fitness centers, community fitness centers

Rules & Regulations

A bathhouse is required for Class A pools:

- Disinfected daily
- Checked periodically
- Liquid soap (not bar soap) and paper towels provided
- Hot water between 90° F and 115° F
- 90° F to 105° F - single temp showers



Source: DHHS

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Rules & Regulations

- No food or drinking permitted **in the pool**
 - Water is allowed in unbreakable containers
- Food and drink allowed in unbreakable containers in designated area only



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Rules & Regulations

- Maintain the pool tub
 - Smooth tub surfaces
 - Cracks caulked
- Hand rails must be secure
- Ladders equipped with slip-resistant treads



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Rules & Regulations

- Depth markers on tub walls and deck required every 25 feet
- Depth markers must be plainly visible from in the pool
- Pools with gutter systems may locate depth markers on interior walls or fence
- **4 INCH SIZE**



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Rules & Regulations

- Pool deck must be in good repair with:
 - No crack over ¼-inch
 - No tripping hazards over ½-inch
 - No low spots for standing water
- Decks free of bags to allow room for emergency person to reach victim
- Facilities in poor repair may result in slips or falls which can often cause injury and subsequent lawsuits



Rules & Regulations

Emergency contact numbers all hours:

- DHHS – 402-525-6601
- Douglas County – 402-444-7000
- Lancaster County – 402-441-8000

Notify the Department IMMEDIATELY (day or night) in the event of a:

- Drowning
- Near-drowning



Notify the Department within 24 hours for accidents requiring hospitalization or medical treatment

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Class A must conduct drills in handling emergencies



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Rules & Regulations

DHHS and LLCHD requires that all Class A pools to have a certified pool operator onsite whenever the pool is open.

DHHS requires Class B and F pools to have a certified pool operator available within 60 minutes.

LLCHD requires that all pools (except Class A) have a certified pool operator available within 60 minutes.

DCHD requires all pools to have a certified pool operator onsite whenever the pool is open.

Operator responsibilities

- Code compliance (**must follow the rules!**)
- Pool & user safety
- Supervising users
- Correctly operating recirculation system
- Testing pool water (**verify water quality****)

**** LLCHD requires pool testers to be certified.**

Rules & Regulations

Lifeguard requirements

- The # required is determined by the # of swimmers and/or the surface area
 - One lifeguard per 100 bathers or 2,000 square feet of water surface area, whichever is the lesser number
 - Class B **and** F pools which elect to have a lifeguard on duty, must provide a lifeguard chair for each 2,000 square feet of water surface area
- Sufficient lifeguards on duty to allow for periodic rest breaks
- Lifeguards must be in position to view all areas of the pool, including the wading pool



Rules & Regulations

Lifeguard qualifications

- Completed nationally recognized course for lifeguards
- CPR certification – **renewed annually**
- Must be able to provide cards upon request



www.cdc.gov/healthyswimming

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Rules & Regulations

Pool Operator CPR?

Boy Recovering After Nearly Drowning in Motel Pool

“A 7-year-old boy is recovering after nearly drowning in an Alliance motel pool. He was not breathing at the time, but an adult administered CPR and had the boy breathing again by the time rescue workers arrived. Authorities say the adult who administered CPR had been certified in the rescue technique only weeks earlier.”

- April 29, 2008 Lincoln Journal Star -

Rules & Regulations

Lifeguards

- Distinguishing swimsuits or emblem must be worn
- Rescue tube
 - Within arm's reach
 - 6 foot long strap/tow rope
 - GOOD REPAIR



Rules & Regulations

Lifeguards

- Water slide requirements
 - Within 50 feet of discharge
 - 3 slide maximum
 - Guard only the slide area
- Lifeguard chairs must be properly located



Rules & Regulations

Lifeguards are not required for

- Swim meets
- Swim classes



www.wikipedia.org

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Rules & Regulations

Class A pools ONLY

- need a backboard with three straps



Source: DHHS

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Rules & Regulations

Class B and F pools

- A rescue tube or ring buoy
- Shall be equipped with a rope as long as the width of the pool



Rules & Regulations

Class B and F pools ONLY

- A shepherd's crook as least 12 feet long
- Conspicuous and accessible



Source: DHHS

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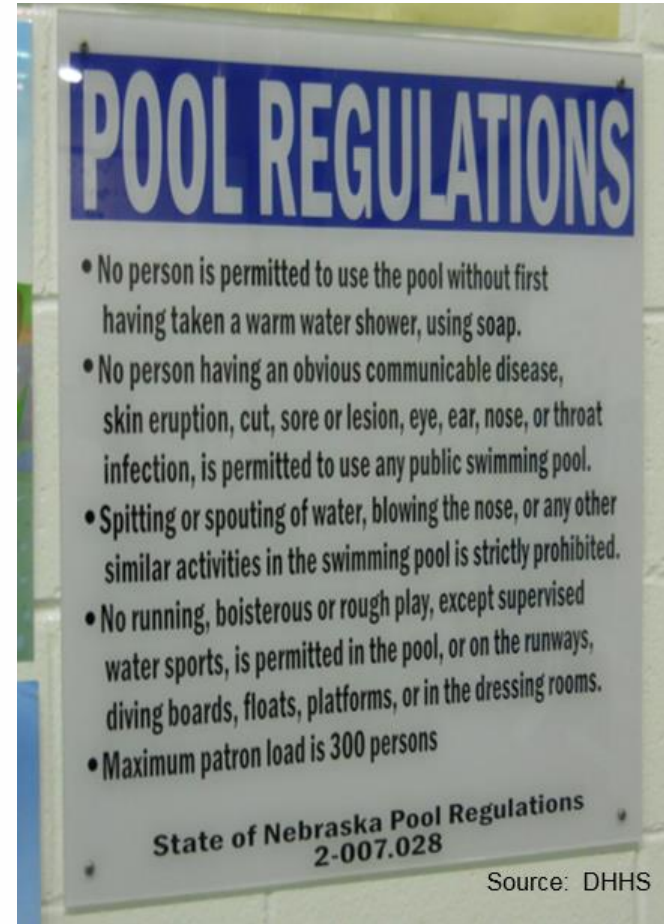
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Rules & Regulations

Signage **ALL POOLS**

- Post rules and regulations
- Post pool capacity



Rules & Regulations

Signage **ALL POOLS**

- “Authorized Personnel Only” on chemical storage rooms
- Storage rooms locked at all times



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Rules & Regulations

Signage

- All pools, except Class A
 - Post no lifeguard signs
 - Only if lifeguards are not provided
 - Children under the age of 16 must not use pool without an adult in attendance
- Class C (spas) “No one under the age of 5 years is permitted in spa”



Rules & Regulations

The boundary between the deep and shallow must be clearly marked:

- Line 4 inches wide on floor and walls
- Safety rope
 - Rope may be removed during lessons, swim meets and lap swim if group is supervised



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Rules & Regulations

The pool shall be completely enclosed:

- Fence 6 feet in height
- Self-closing/self-latching gate**
- Recommended latch height at 54 inches
- No gaps greater than 4 inches

**** IMMEDIATE closure item**



Source: DHHS

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Rules & Regulations

A telephone with emergency numbers posted:

- 9 + number if needed
- Include name and address of facility

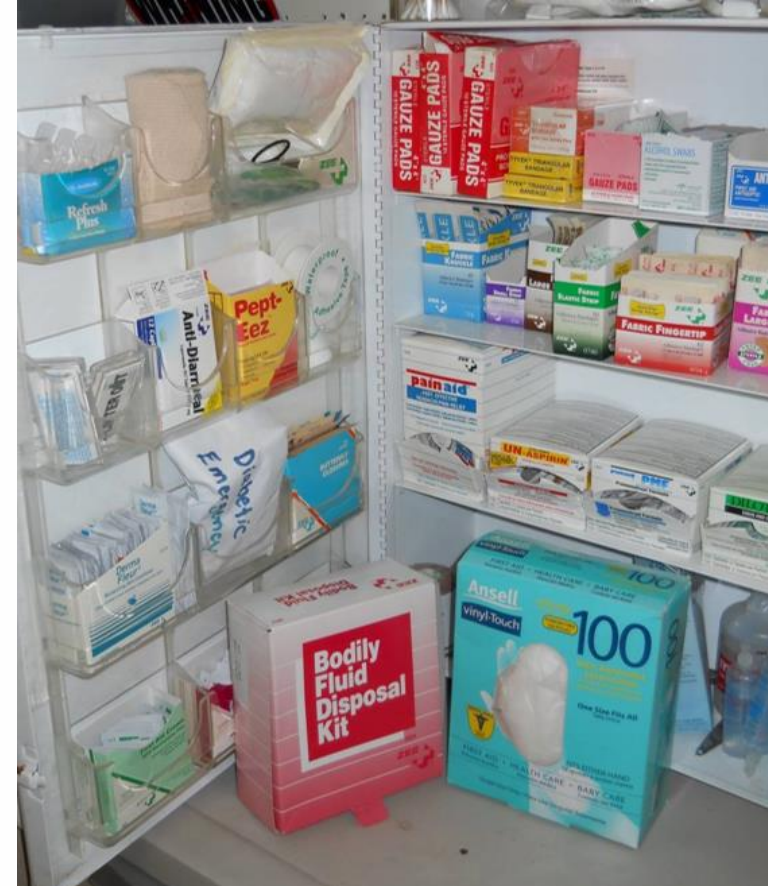
**** Pools operating without a hardwired phone will be closed immediately (no cell phone) ****



Rules & Regulations

First Aid Kit

- Class A pools must have all items listed in regulations (Chapter 2, page 6)
- All other pool classifications need a first aid kit



Rules & Regulations

- Water must be free of floating and suspended materials
- Water must be clear to easily see the drain cover



Rules & Regulations

Indoor pools require:

- CO detector
 - If a gas heater is used
- In the pool area
- In mechanical room



Rules & Regulations

SANITIZER

- Pools shall be maintained at a MINIMUM of 2.0 ppm free chlorine **
- Pools shall be maintained at a MINIMUM of 2.0 ppm bromine **

**** IMMEDIATE closure items**



www.POOLCENTER.com

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Rules & Regulations

SANITIZER

- Spas shall be maintained at a MINIMUM of 3.0 ppm free chlorine **
- Spas shall be maintained at a MINIMUM of 4.0 ppm bromine **

**** IMMEDIATE closure items**



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Rules & Regulations

SANITIZER

- Pools shall be maintained at a MAXIMUM of 10 ppm free chlorine **
- Pools shall be maintained at a MAXIMUM of 18 ppm bromine **

**** IMMEDIATE closure items**



Source: DHHS

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Rules & Regulations

Water Quality

- pH shall be maintained between 7.2-7.8 **
- Combined chlorine shall not exceed 0.5 ppm **
- Cyanuric acid exceeding maximum 90 ppm **
- Total alkalinity shall be no less than 80 ppm

**** IMMEDIATE closure items**



Rules & Regulations

- Test the sanitizer and pH multiple times daily
 - Before opening
 - Every 4 hours until closing
- Test total alkalinity, combined chlorine and cyanuric acid weekly
- Must be kept on Chapter 2 log sheet or equivalent form



Rules & Regulations

- Pool log is a 1 year* record of:
 - Test results
 - Chemistry adjustments
 - Equipment maintenance
 - Patron loads



* Douglas County requires keeping records 3 years

- Keep current copy of pool operator card on-site!

Rules & Regulations

Reasons to close a pool:

- 8. Lifeguards are not present
- 9. Pool operator is not present or available
- 10. Weather conditions are threatening
- 11. A fecal accident has occurred
- 12. Excessive dirt, floating matter or objects in pool
- 13. Gate/door to pool is not self-closing and self-latching



Rules & Regulations

Reasons to close a pool:

1. Sanitizer is not within required range
2. Combined chlorine exceeds maximum level
3. pH is not within required range
4. Cyanuric acid exceeds maximum 90 ppm
5. Pool drain cover is not clearly visible
6. Accessible working hardwired phone with emergency numbers posted
7. Safety equipment is not available



Circulation & Filtration

- Circulation is a closed system in which water is removed and returned to the pool
- Filtration is the physical removal of particles through a filtration media



Circulation & Filtration

Circulation requirements

- Operate 24 hours a day
 - Effective sanitizer dilution
 - Proper sanitizer distribution



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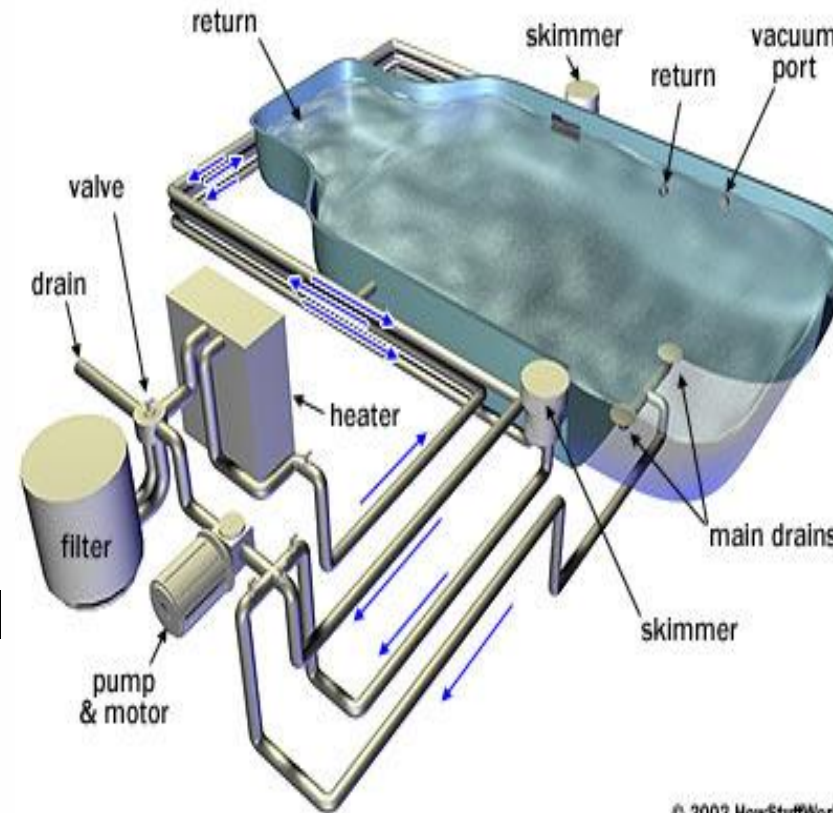
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Circulation & Filtration

Circulation is influenced by:

- Inlet placement and design
- Circulation pumps
- Pool shape and contour
- Piping and fittings
- Surface and main drain water removal
- Other systems such as heaters



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Circulation & Filtration

- Return lines can be adjusted as needed
- Modified by changing orifices



Source: DHHS

Good Circulation

Circulation & Filtration

Gutter systems

- Maintain water level for removal of floating debris and for continuous overflow of water
- Maintain grates, remove and clean



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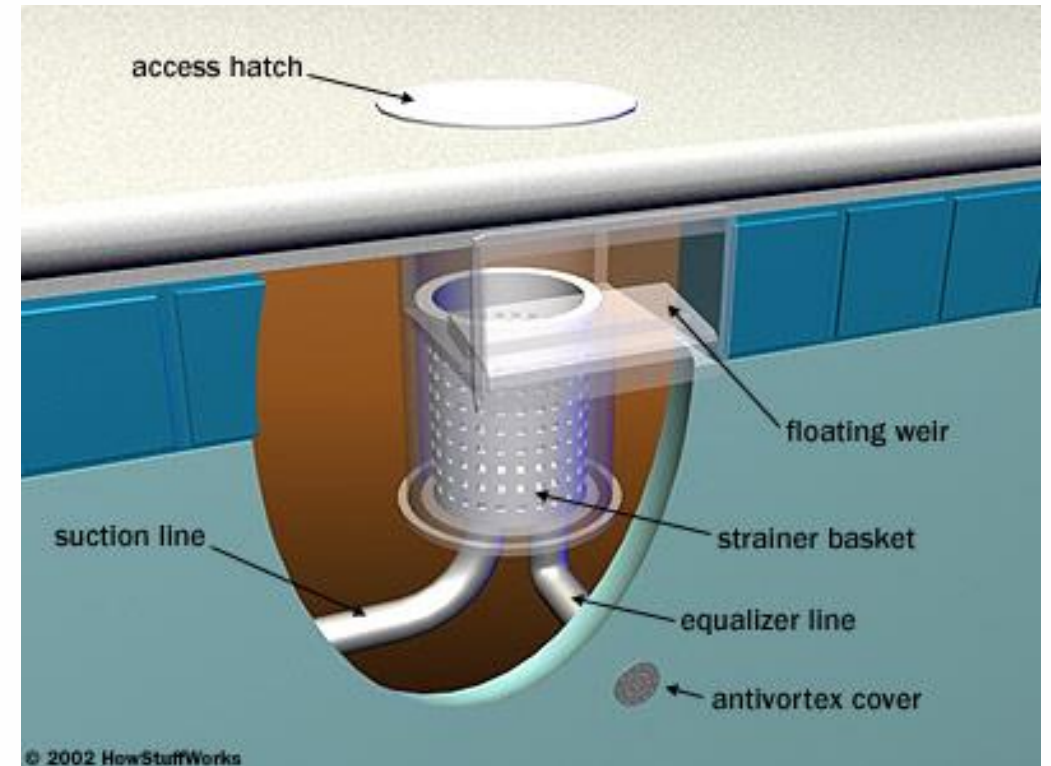
Circulation & Filtration

Skimmers

- Point source removal
- Removable basket to trap large solids
- Maintain the water level



Source: DHHS



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THEY ARE NOT CHLORINATORS!!

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Circulation & Filtration

Skimmers

- CLEAN OUT STRAINERS AS NEEDED!!



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Circulation & Filtration

Filtration room

- Inlet Pipes
- Hair Strainer
- Pump/Impeller
- Motor
- Filters
- Chemical Feeders (always last!)
- Return Pipes



Source: DHHS

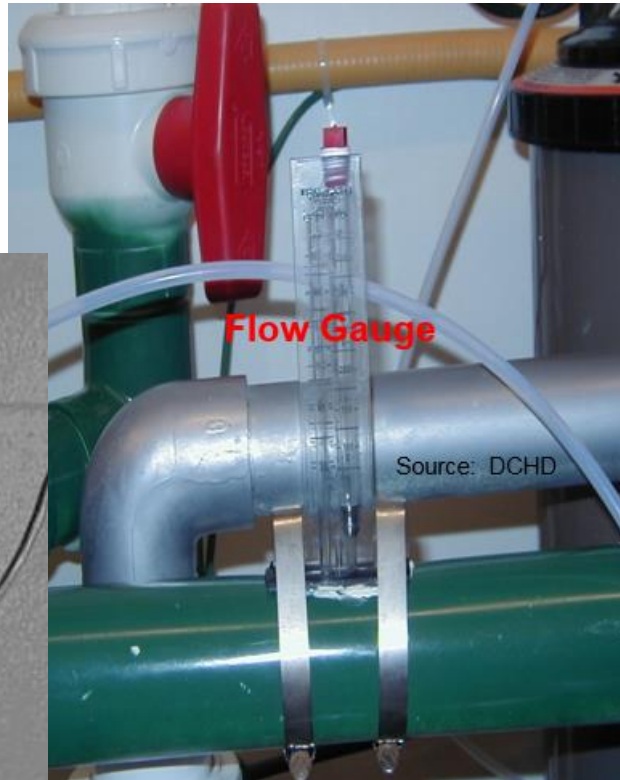
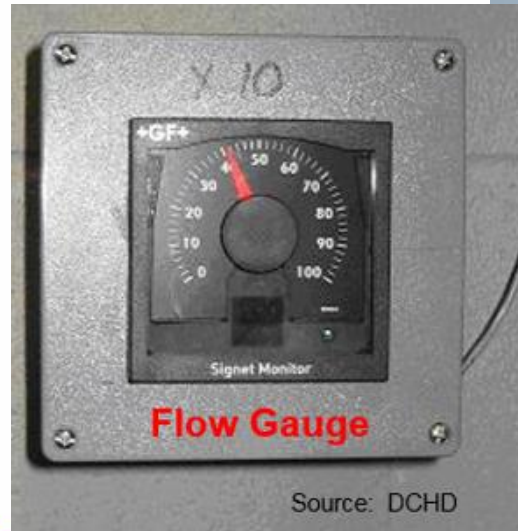
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Circulation & Filtration

Flow Gauge (Required)

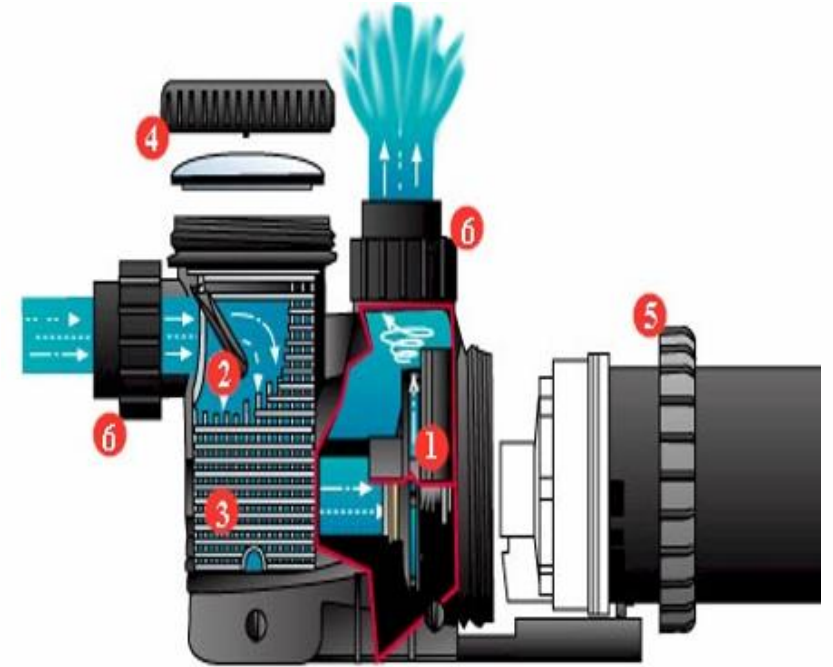
- Measures the flow of water in GPM
- Determines turnover rate
- 10-15% inaccuracy
- Check daily!!



Circulation & Filtration

If the flow rate changes

- Check the skimmer basket
- Check the pump impeller
- Check the filter gauges
- Check the filter media
- Check for obstructions in the piping or equipment



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Circulation & Filtration

Turnover rate

- Time for entire volume of water to be filtered
- Based on pool volume ($L \times W \times D \times 7.5 = \text{volume}$)
- Turnover rate equals:
 - Volume of pool divided by flow rate divided by 60
 - $60,000 \div 300 \text{ gpm} \div 60 = 3 \text{ hours } 20 \text{ minutes}$

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Circulation & Filtration

Type or Depth of Pool Required Turnover Rate

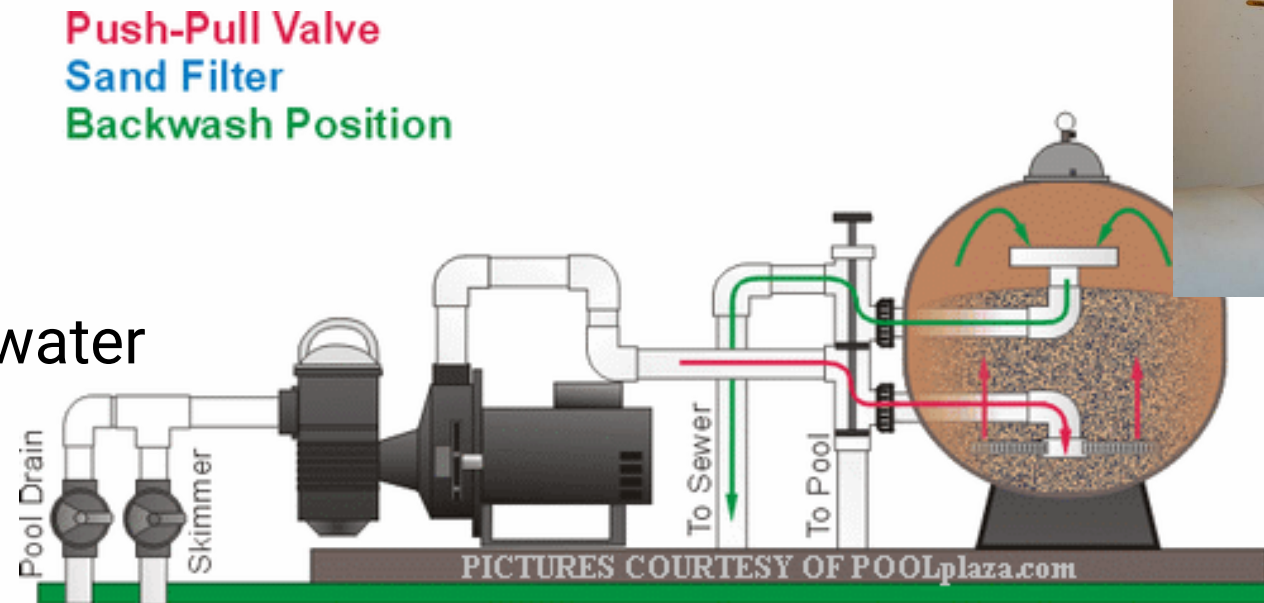
- Spray parks with no standing water
 - One system volume of water every 30 minutes or less
- Pool areas less than or equal to 2 feet in water depth
 - One pool volume of water every 1 hour or less
- Pool areas greater than 2 feet but less than or equal to 3 feet in water depth
 - One pool volume of water every 2 hours or less
- Pool areas greater than 3 feet but less than or equal to 5 feet in water depth
 - One pool volume of water every 4 hours or less
- Pool areas greater than 5 feet in water depth
 - One pool volume of water every 6 hours or less

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Circulation & Filtration

Filter effectiveness

- Type of filter
- Surface area
- Velocity of water
- Condition of media
- Particulates in the water



Circulation & Filtration

Filtration systems (two types)

- **Pressurized**
 - Pump located ahead of filter
 - Closed tank
 - Cleaning based on pressures involved
 - Watch pressure gauges
 - Reverse flow to clean (usually)



Sand Filter

www.POOLCENTER.com

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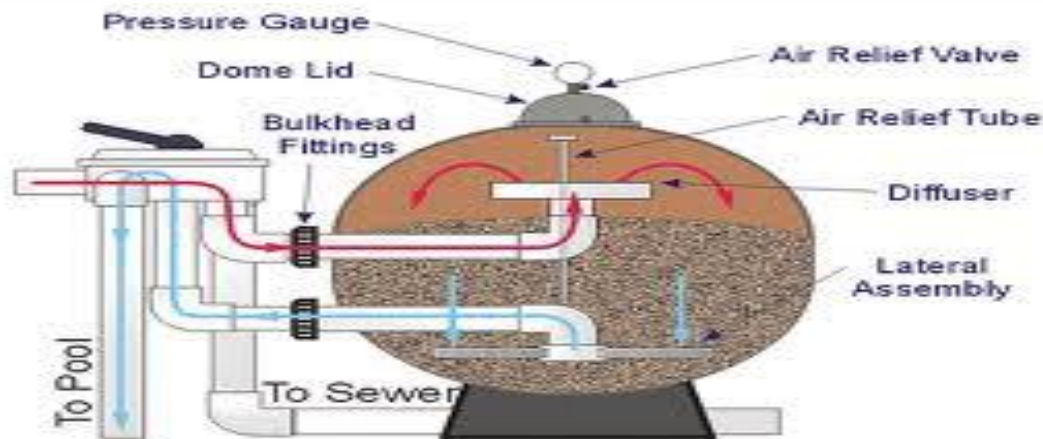
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Circulation & Filtration

Filtration systems (two types)

- Cleaning based on pressures involved
 - Watch pressure gauges
 - Reverse flow to clean (usually)
 - Sight glass clear



Source: DHHS

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Circulation & Filtration

Filtration system (two types)

- **Suction (vacuum)**
 - Pump located behind filter
 - Open system
 - Cleaning – physically removing the filter powder
 - Water pressure gauges
 - Inspect condition of cloth elements



Circulation & Filtration

Media types

- Sand
 - Gravity
 - Rapid sand
 - High rate sand
- Diatomaceous earth
- Cartridge



Source: DHHS

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Circulation & Filtration

Filtration gauges

- **Must be operational!!**



www.POOLplaza.com

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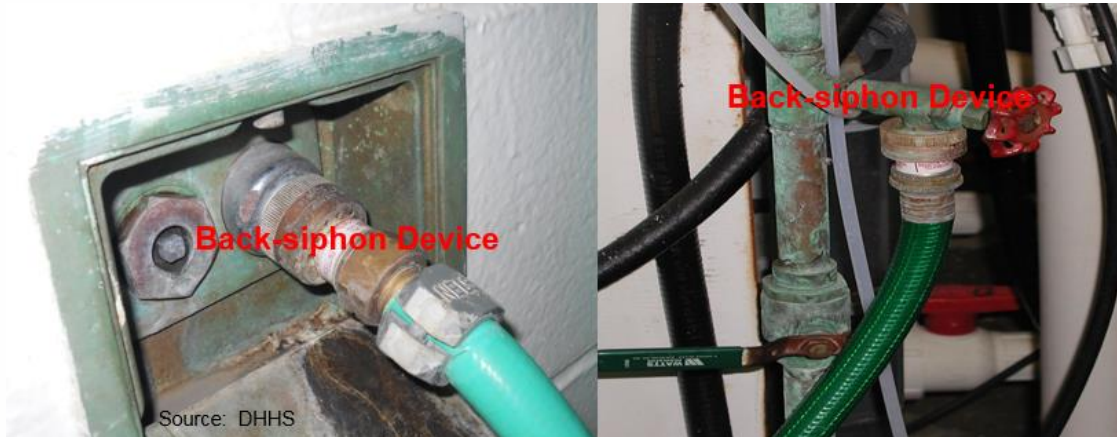
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Circulation & Filtration

Protect all potable water supplies with:

- An air gap
- A back-siphon device



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Circulation & Filtration

VGB Act Standards

Entrapment

- Hair
- Jewelry
- Limb
- Whole body



Photo: Pool Safety Council

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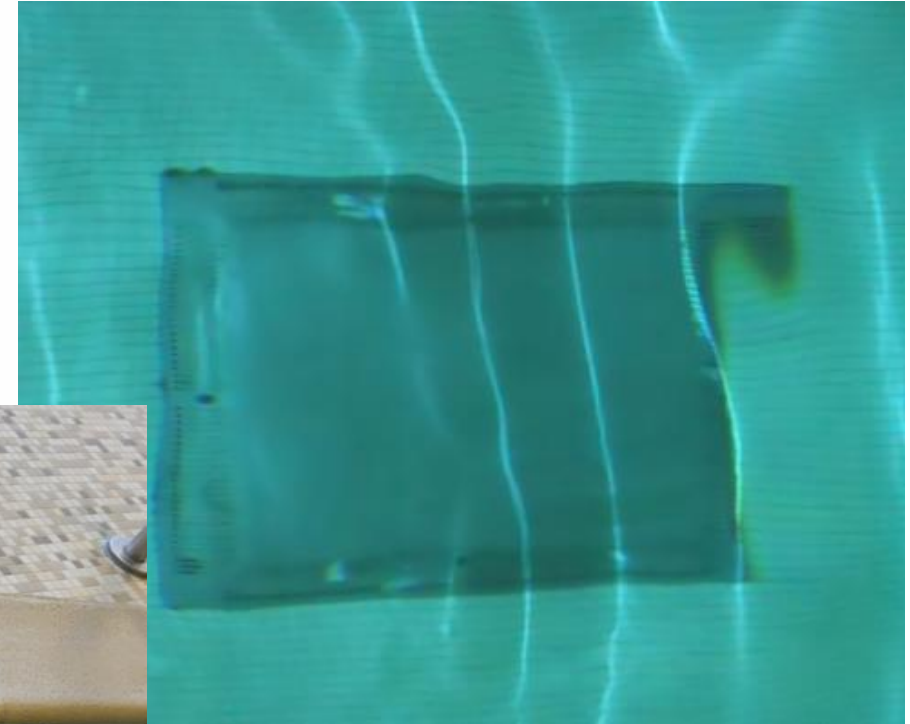
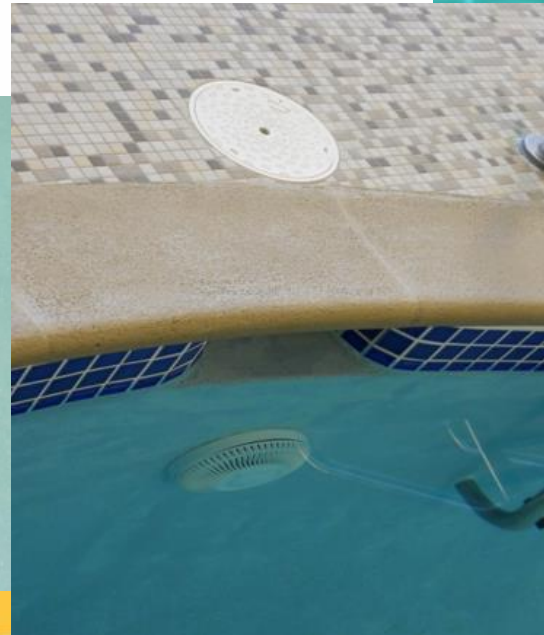
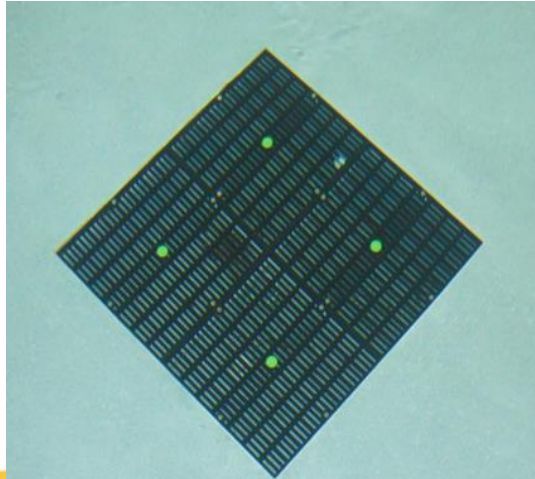
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Circulation & Filtration

VGB Act Standards

Drain covers:

- **MUST** be in place and secure
- Check drain cover replacement dates
 - Replace if needed



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Circulation & Filtration

ADA requirements

ADA requires that facilities be readily accessible to, and usable by, individuals with disabilities.

www.ada.gov/pools_2010.htm

800-872-2253 ADA technical help line

Circulation & Filtration

ADA Standards

- Plans and specs **MUST** be submitted if modifications to the pool are being made
 - Stairs, ramps, transfer walls/stairs
- NO plans and specs required for a lift, temporary stairs or ramps



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Circulation & Filtration

Questions

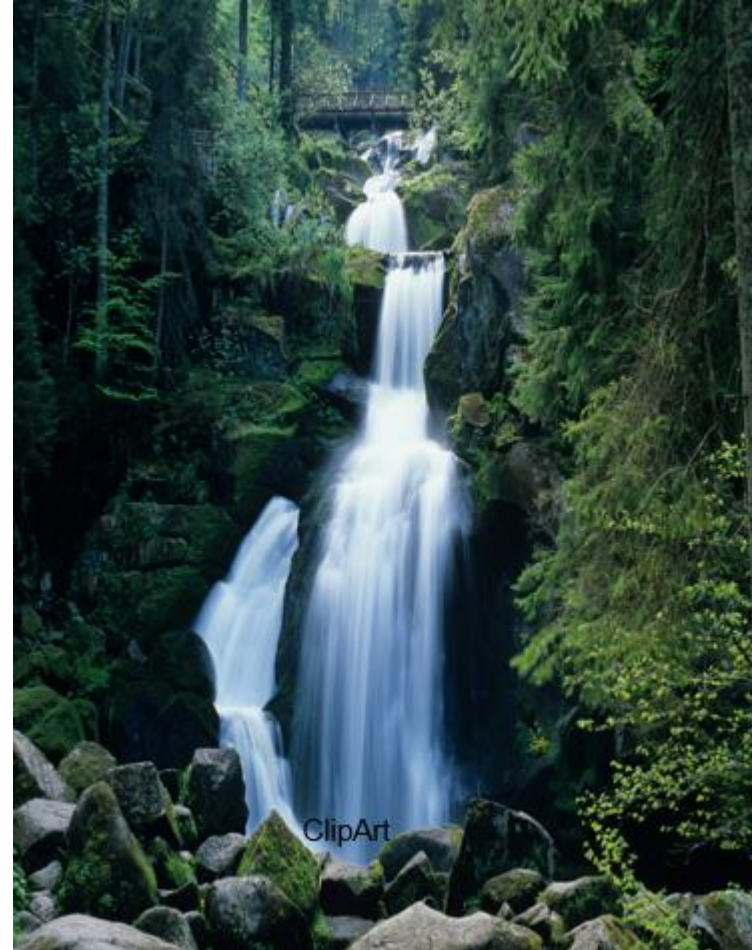
- Refer to equipment manual
- Contact equipment manufacturer
- Contact pool service provider

Water Balance

Chemistry of water

Water is a universal solvent

- Balanced
- Corrosive
- Scale forming



Water Balance

Proper water balance will:

- Optimize the sanitizer (chlorine/bromine)
- Extend the life of pool equipment
- Provide for bather comfort
- Improve filter runs
- Maintain clear water



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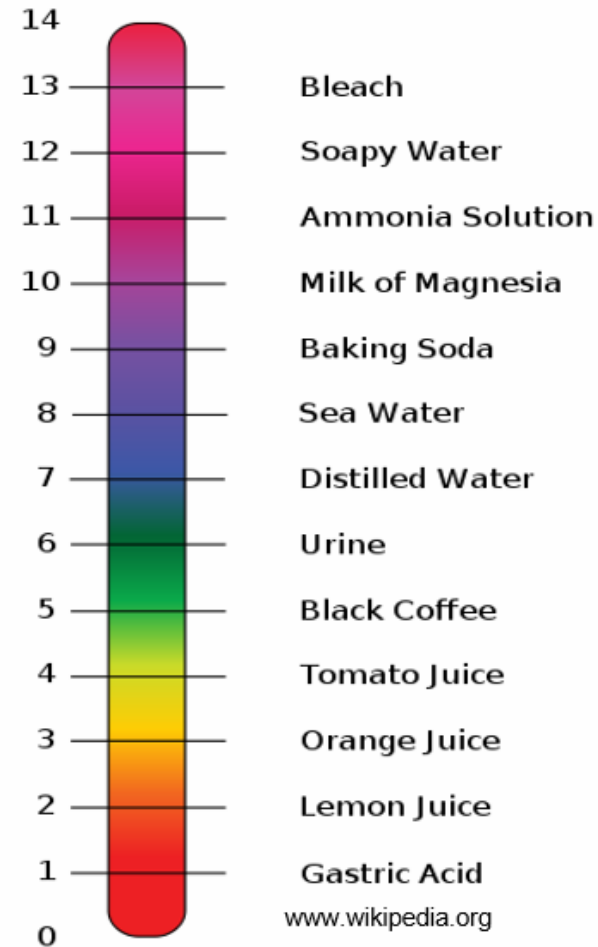
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Water Balance

Balanced water is the correct ratio of:

- pH
- Total alkalinity
- Calcium hardness
- Temperature

All are dependent of each other



Water Balance

pH

- Has the greatest affect on pool water
- Measures how acidic or basic a solution is
- Distilled water has a pH of 7.0
- Human skin pH between 4.5-6.0
- A pH of 7.4-7.6 is ideal



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Water Balance

What affects pH

- Chemicals used
- Swimmers
- Weather and environment
- Water source
- Algae



Source: Joe Sullivan at wikipedia.org



Source: de:Benutzer: Alex Anlicker at wikipedia.org

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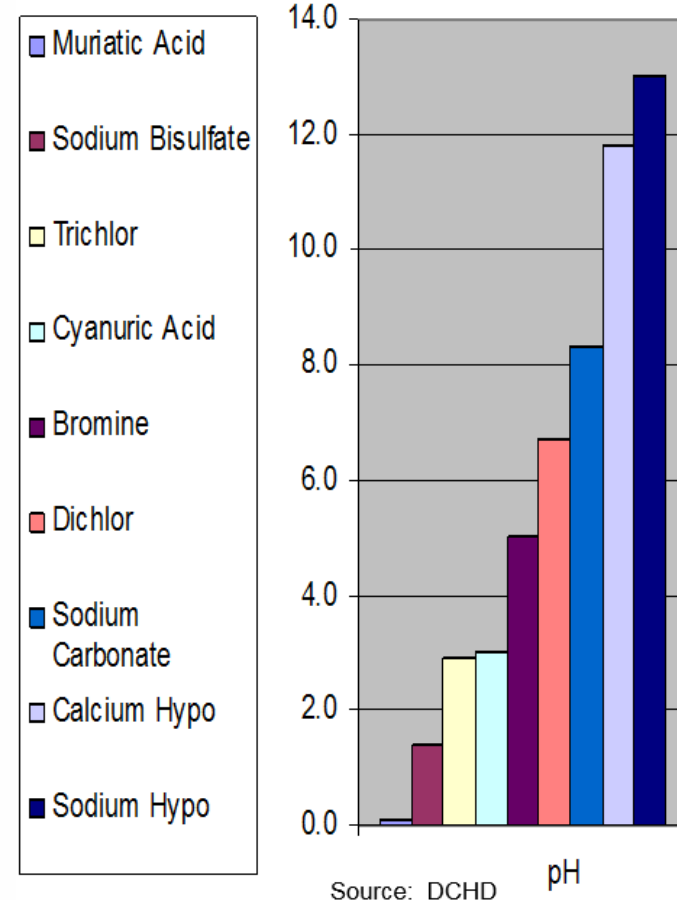
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Water Balance

pH values of chemicals used are:

- Muriatic acid – 0.1
- Sodium bisulfate – 1.4
- ***Trichlor* – 2.9**
- Cyanuric acid – 3.0
- Bromine – 5.0
- ***Dichlor* – 6.7**
- Sodium carbonate – 8.3
- ***Calcium hypo* – 11.8**
- ***Sodium hypo* – 13.0**

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Water Balance

Chlorine & pH

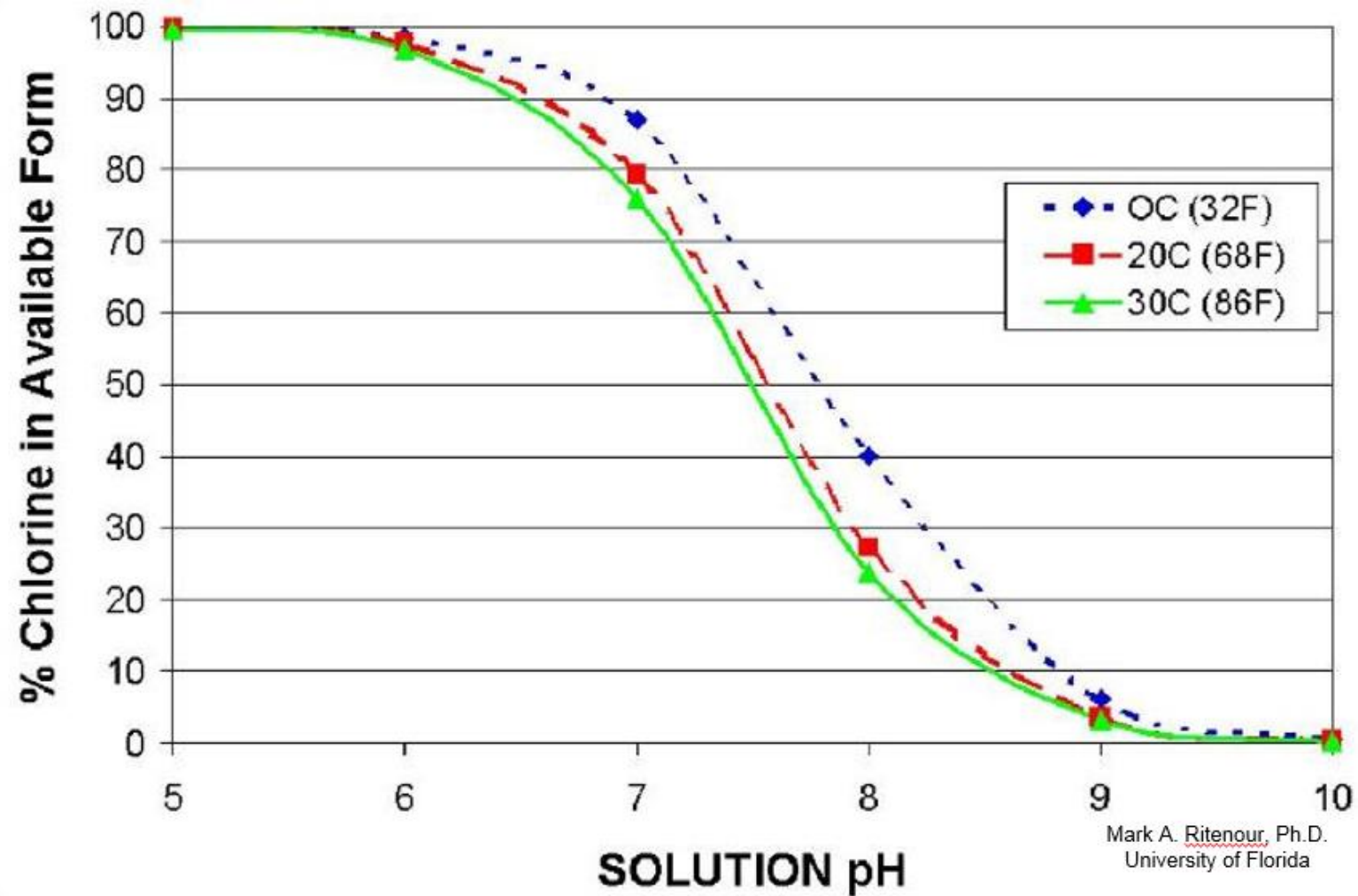
Two products are formed when water and chlorine are mixed

- Hypochlorous acid – effective sanitizer
- Hypochlorite – less effective sanitizer

<u>Hypochlorous Acid</u>	<u>pH</u>
66%	7.2
50%	7.5
33%	7.8
0%	over 8.0

The amount of hypochlorous acid and hypochlorite produced is: **pH dependent**

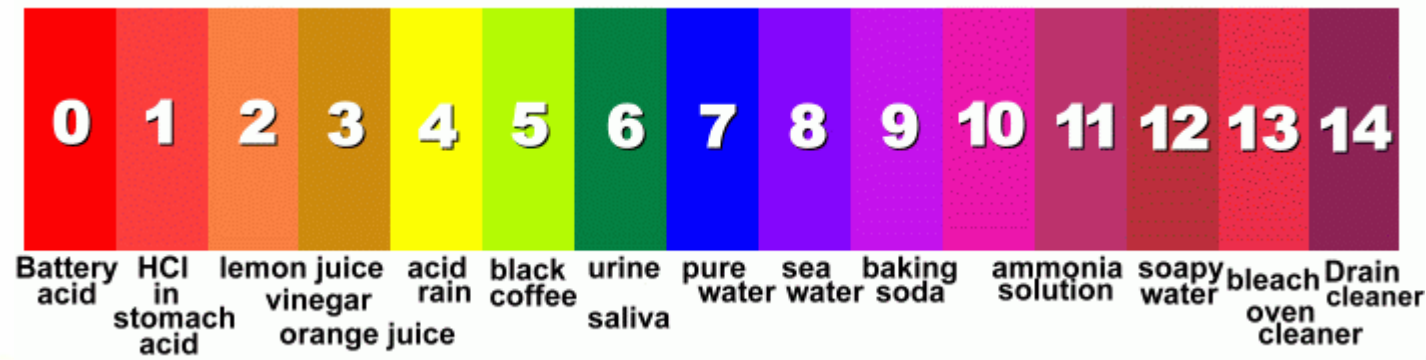
Water Balance



Water Balance

High pH (7.9 or higher)

- Scale formation
- Water becomes cloudy
- Filter runs are shorter
- Chlorine is ineffective
 - Increased risk of disease



Water Balance

Low pH (7.1 or lower)

- Water becomes acidic
- Chlorine dissipates rapidly
- Eye irritation occurs
- Plaster walls are etched
- Metal corrodes
- Dissolved metals leave stains
- Rapid loss of alkalinity



Water Balance

Raise pH

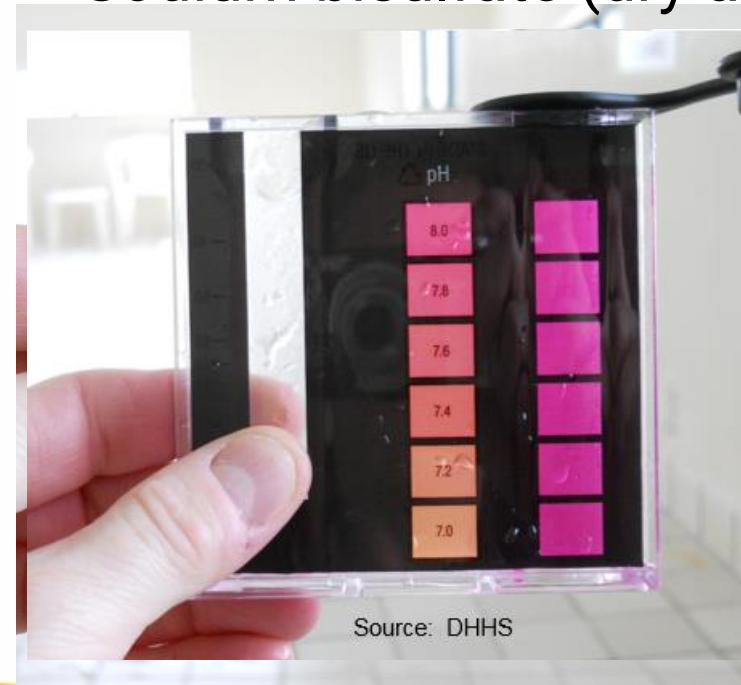
- Sodium carbonate (soda ash)*

Follow label directions and adjust in small doses

* Adding too much too fast causes milky white water

Lower pH

- Muriatic acid
- Sodium bisulfate (dry acid)



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Water Balance

Total alkalinity is a measure of the water's ability to fight pH change

High alkalinity

- pH lock
- Cloudy water
- Scale

Low alkalinity

- Unstable
- Corrosive
- pH bounce



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Water Balance

Total alkalinity

- Maintain at 80 ppm or higher for a stable pH
- To raise:
 - Add sodium bicarbonate*
 - Baking soda
- To lower:
 - Add an acid
 - Muriatic acid
 - Sodium bisulfate

Add slowly and make adjustments in small doses

ALWAYS follow manufacturer's recommendations!

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Water Balance

Temperature

- Affects how chemicals dissolve
- Most chemicals dissolve better as temperatures increase
- Hardness (calcium carbonate) reacts the opposite



Source: DHHS

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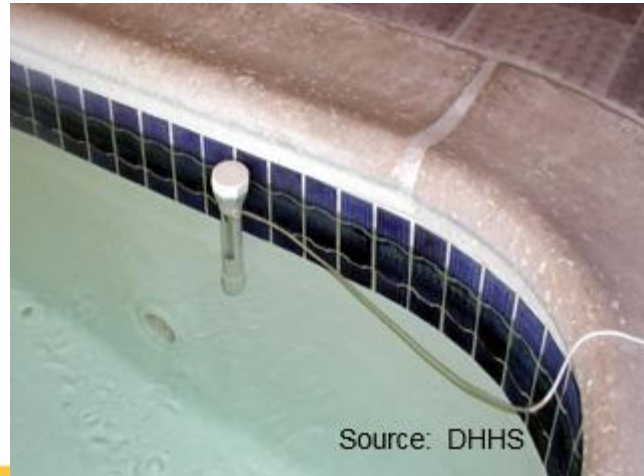
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Water Balance

Temperature

- Ideal range for pools
 - 80° F – competition swimming
 - 78° F to 82° F – recreation
- Thermometers are only required for spas
 - **104° F maximum**



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Water Balance

To make chemical adjustments, you need to know

- How much of a change is needed
- Proper chemical to make change
- Pool volume

Sequence for testing/adjustments

- Total alkalinity, pH then sanitizer



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Water Balance

When adding large amounts of chemicals to make a chemical adjustment:

- Do so in smaller doses, if possible, over several days
- NEVER add chemicals when pool is occupied
- ***Follow manufacturer's guidelines***



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Water Treatment

Sanitization

- Destroying pathogenic organisms (bacteria, fungi, protozoa, viruses...) harmful to human health in order to control communicable disease

Oxidation

- Chemically removing organic debris (perspiration, saliva, urine, body oils and wastes, particulate matter...) from the water
 - The chemical cleaning of the pool water

- Converts sweat, debris, urine and other organics into gases
- Non-chlorine treatment for oxidation available
- The terms shock, oxidation and superchlorination are use interchangeably

Water Treatment

Sanitizers facilitate oxidation of pool water

- Primary sanitizers (residuals)
 - Chlorine
 - Granular, tablet, gas, liquid
 - Bromine
 - Granular, tablet, liquid
- **Secondary** sanitizers
 - Ozone
 - Ultraviolet light



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Water Treatment

Stabilized Chlorine / Stabilizer – Cyanuric Acid

- Protects chlorine from sun
 - Maintain at 25-40 ppm*
 - Lower by dilution
 - For outdoor pools only
- * LLCHD recommends not exceeding 30 ppm

NEVER MIX STABILIZED AND UNSTABILIZED FORMS OF CHLORINE!

- >15 ppm lowers chlorine efficacy
- >80 ppm may result in... CHLORINE LOCK
- If cyanuric acid exceeds the maximum 90 ppm **

**** IMMEDIATE Closure Item**

Water Treatment

Use of Stabilized Chlorine INDOOR POOLS????

- New indoor pools
 - NOT ALLOWED
- Existing indoor pools
 - Must switch sanitizer type when existing stabilized chlorinator stops working



Water Treatment

Dichlor feeders

- Automatic system for fast dissolving sanitizers

Liquid feeders

- Sodium hypochlorite
- Not very stable – loses strength
- Very high pH – acid feeders included

Erosion feeders

- Trichlor application to pool
- Slow dissolving chlorine
- Operation affected by: solubility (low), water temperature, flow rate, amount of product in feeder

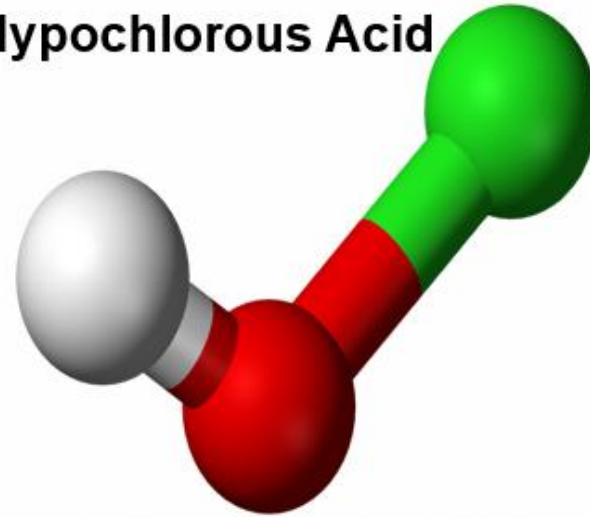


Water Treatment

Chlorine is the most common sanitizer

- Effective at killing organisms which cause disease
- Strong oxidizer of perspiration, saliva, urine, body oils & waste
- **Disadvantage:** reacts with ammonia to form chloramines causing “chlorine odor”

Hypochlorous Acid



Source: Ben Mills and [Ephemerium](https://en.wikipedia.org/wiki/Hypochlorous_acid) at wikipedia.org

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Water Treatment

Chloramines are formed when chlorine and the following combine:

- Organic waste
- Body waste (urine)
- Particulate matter
- Perspiration
- Oils and lotions
- Nitrates

Hence – COMBINED CHLORINE!

Use your test kit to check for combined chlorine

– shall not exceed 0.5 ppm

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Source: DHHS

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Water Treatment

Minimize combined chlorine by being proactive

- Require patrons to shower with soap before entering the pool
- Maintain a high free chlorine level (combined chlorine will not accumulate)



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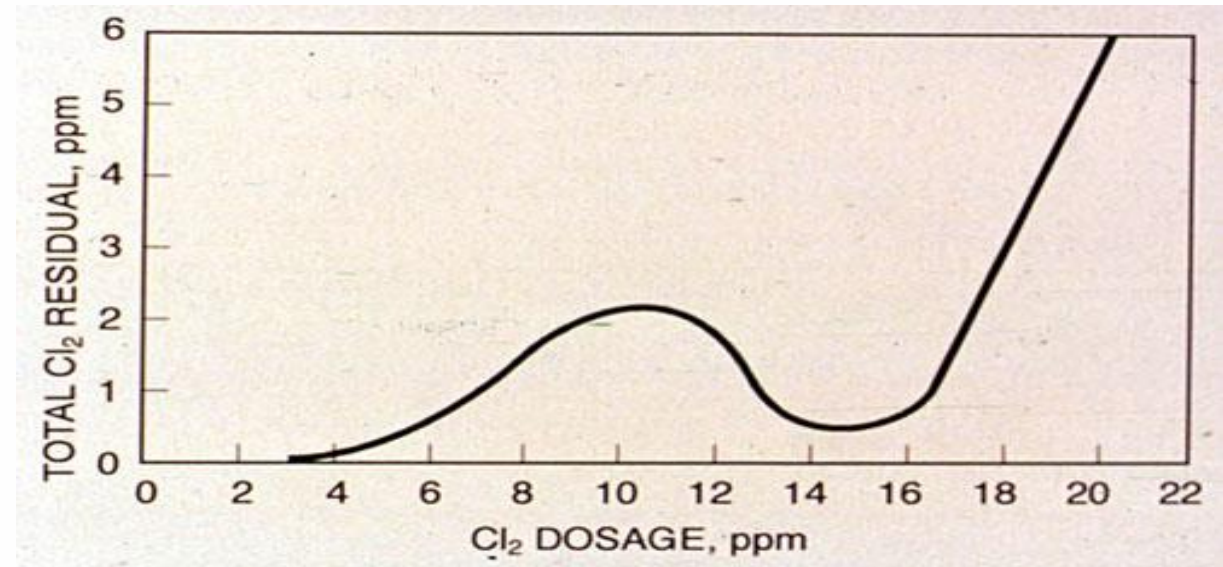
Water Treatment

Eliminate bad (combined) chlorine

Option 1

Breakpoint chlorination

- Dramatically increasing chlorine levels over the breakpoint dose for a short period of time completely oxidizes combined chlorine
- Minimum amount of chlorine needed to remove combined chlorine
- Adding less than the breakpoint dosage can create more combined chlorine



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Water Treatment

Eliminate bad (combined) chlorine

Option 2

SHOCKING...SUPERCHLORINATION

Breakpoint = 10 X combined chlorine level

Example: water test indicates 0.8 combined chlorine

$10 \times 0.8 = 8.0 \text{ ppm}$

Solution: add 8 ppm MORE chlorine than what the pool is currently at

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Water Testing Methods

Why test pool water?

- It is REQUIRED!
 - Before opening and every 4 hours until close
 - Balanced water
 - Good water clarity
 - Control algae growth
 - Save money on chemical use and equipment maintenance
- Healthy environment for swimmers
 - Proper sanitation
 - Good water quality
 - **Valuable tool during complaints and lawsuits**



Water Testing Methods

Test kit must be accurate and reliable to measure:

- Free chlorine/bromine (FAS-DPD kit **REQUIRED**)
- Combined chlorine
- pH (7.0 - 8.0 range)
- Total alkalinity
- Cyanuric acid – if used



Recommendation for accurate results

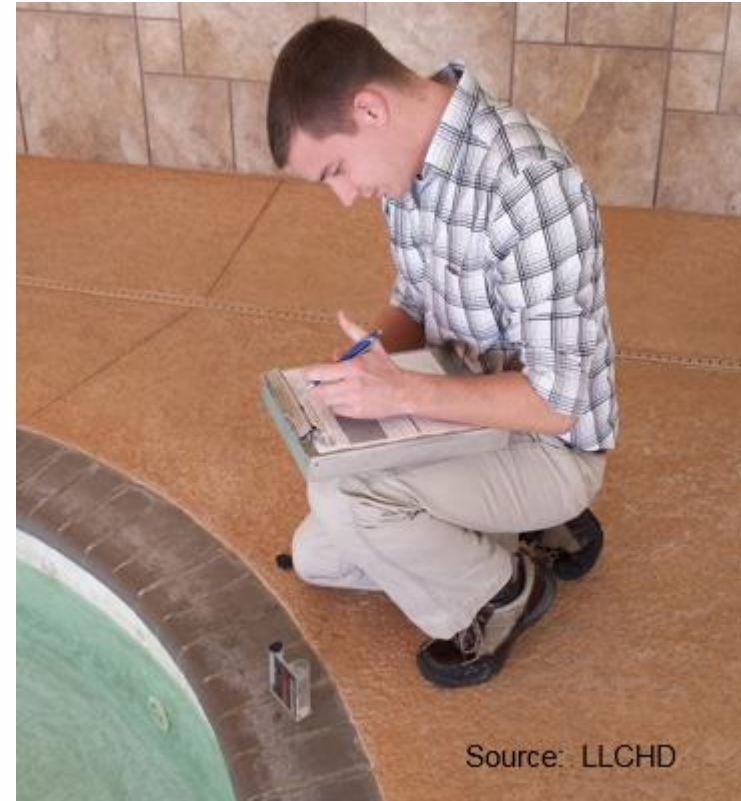
- Use fresh reagents
- Do not store reagents in chemical storage areas
- Store reagents in cool, dark location



Water Testing Methods

Testing procedures

- Test sanitizer level and pH before opening and every 4 hours until close
- Test total alkalinity, combined chlorine and cyanuric acid weekly
- Must be **recorded** on log sheet or equivalent form



Source: LLCHD

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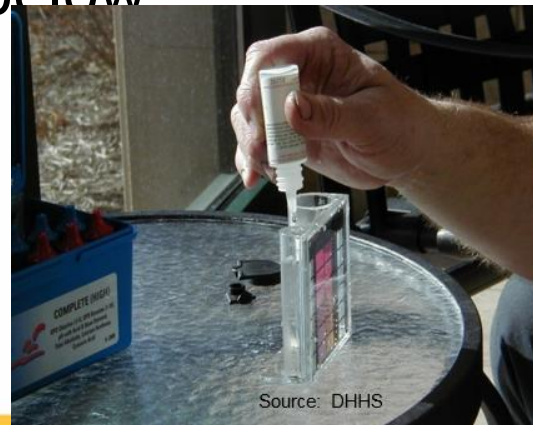
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Water Testing Methods

Testing procedures

- Sample represents entire body of water
- Recommend using multiple sample locations
- Collect sample 12-18 inches below water surface
 - Not in front of inlets



Source: DHHS

Proper procedures

- Rinse comparator tubes three times
- Measure carefully
 - Pause between drops
- Hold reagent tubes vertical



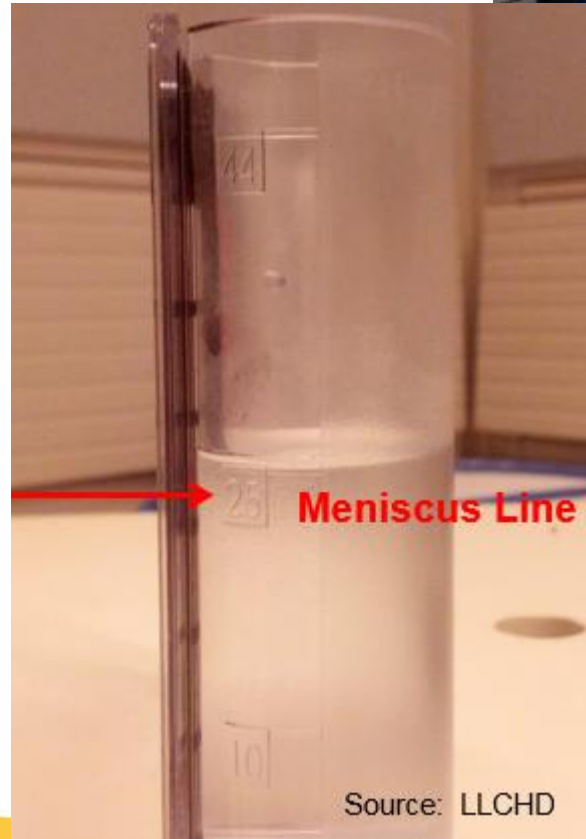
Source: LLCHD

Water Testing Methods

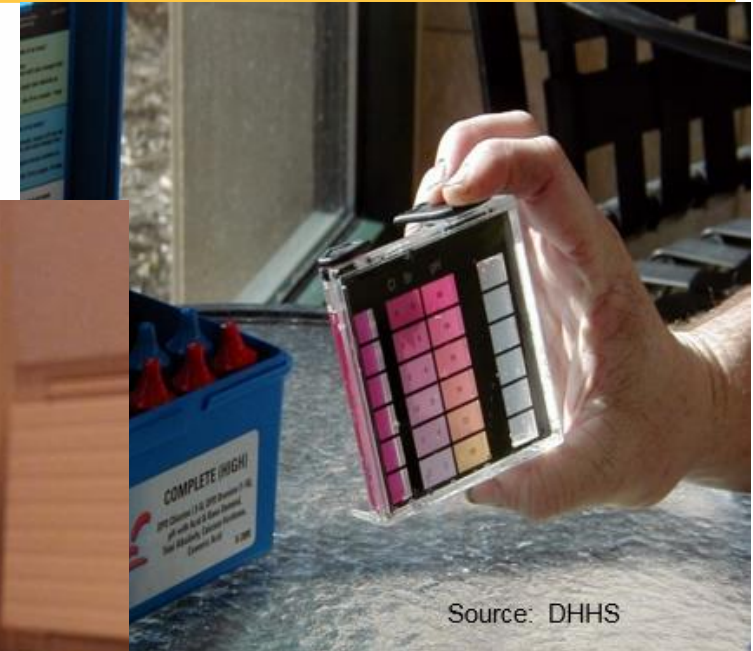
Testing procedures

- Swirl...Swirl...Swirl
- Do not shake the samples (may affect pH result)
- Use cell caps, if applicable (fingers contaminate the sample)
- Proper lighting will provide accurate readings
- Read results against light background
- Hold at eye level and measure from bottom of meniscus line

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Source: LLCHD



Source: DHHS

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Water Testing Methods

How To - Free Chlorine (example from Taylor test kit*)

- Fill to either 10 ml or 25 ml line
- Add 2 dippers R-0870 DPD powder
- Add R-0871 DPD titrating reagent, count drops and swirl after each until color changes from pink to clear
- Multiply drops
 - 10 ml sample 1 drop = 0.5 ppm
 - 25 ml sample 1 drop = 0.2 ppm
- Example
 - @ 10 ml: 10 drops x 0.5 = 5 ppm chlorine
 - @ 25 ml: 10 drops x 0.2 = 2 ppm chlorine

* Other test kits available, follow kit instructions

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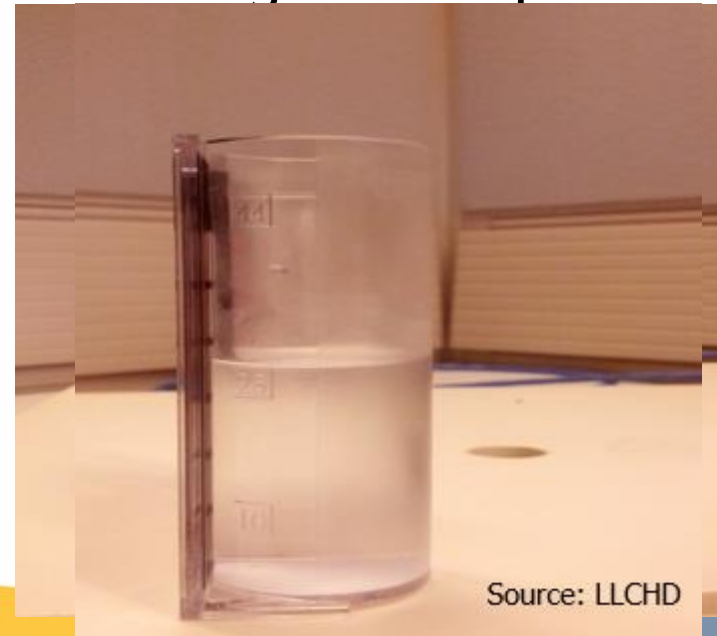
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Water Testing Methods

How To - Free Chlorine

Water Testing Problem

- During chlorine test, sample turns pink, but during swirling sample goes clear
 - Caused by very high levels of chlorine bleaching out the powder



Source: LLCHD

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Water Testing Methods

How To - Bromine (example from Taylor BROMINE test kit*)

- Same procedures as free chlorine...EXCEPT
- Multiply drops
 - 10 ml sample 1 drop = 1.25 ppm
 - 25 ml sample 1 drop = 0.5 ppm
- Example
 - @ 10 ml: 4 drops x 1.25 = 5 ppm bromine
 - @ 25 ml: 4 drops x 0.5 = 2 ppm bromine

* Other test kits available, follow kit instructions

Water Testing Methods

How To - Bromine

Testing Bromine using a Chlorine test kit

(directions from Taylor testing guide book)

- Same procedures as free chlorine...EXCEPT
- Multiply final result number by 2.25 ppm
- Example
 - @ 10 ml: Result of 5 ppm x 2.25 = 11.25 ppm bromine
 - @ 25 ml: Result of 2 ppm x 2.25 = 4.5 ppm bromine

Water Testing Methods

How To - Combined Chlorine (example from Taylor test kit*)

- Immediately after the free chlorine test, with the same sample
- Add 5 drops of R-0003 DPD reagent
- Add R-0871 DPD titrating reagent, count drops and swirl after each until color changes from pink to clear
- Multiply drops
 - 10 ml sample 1 drop = 0.5 ppm
 - 25 ml sample 1 drop = 0.2 ppm
- Example
 - @ 10 ml: 1 drop x 0.5 = 0.5 ppm chlorine
 - @ 25 ml: 3 drops x 0.2 = 0.6 ppm chlorine

* Other test kits available, follow kit instructions



Source: DHHS

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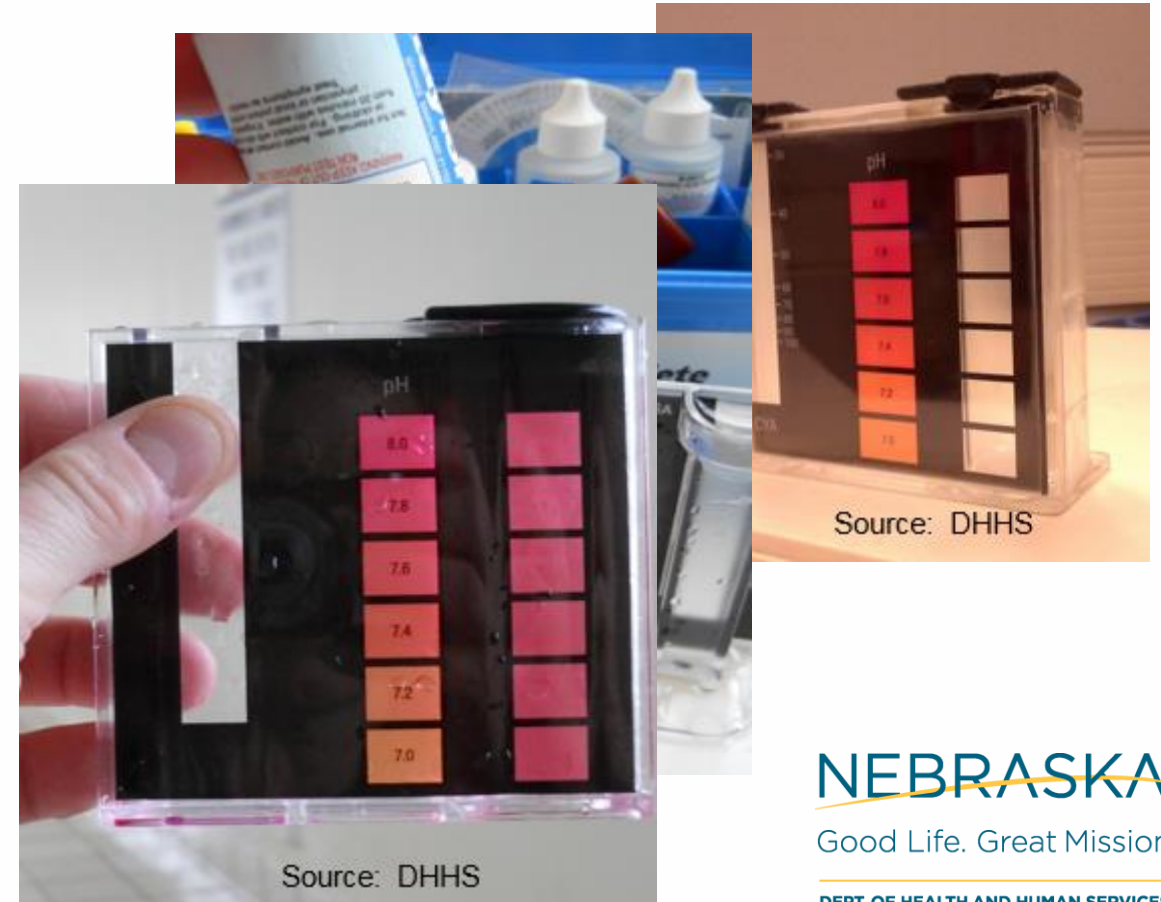
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Water Testing Methods

How To - pH (example from Taylor test kit*)

- Fill to 44 ml line
- Add 5 drops R-0004 pH indicator solution, invert 2 or 3 times to mix
- Match color with color comparator

* Other test kits available, follow kit instructions



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Water Testing Methods

How To - pH

Water Testing Problem

- Elevated chlorine, pH results might show a purple color instead of yellow to red
 - Caused by high chlorine interfering with phenol red reagent
 - Correct by adding one drop of sodium thiosulfate (chlorine neutralizer) before adding pH reagent



Water Testing Methods

How To - Cyanuric Acid (CYA) (example from Taylor test kit*)

- Fill CYA dispensing bottle to 7 ml line
- Add R-0013 cyanuric acid reagent to 14 ml, mix for 30 seconds
- Slowly add to small comparator tube until black dot disappears
- Match liquid level with comparator on the front

* Other test kits available, follow kit instructions

Water Testing Methods

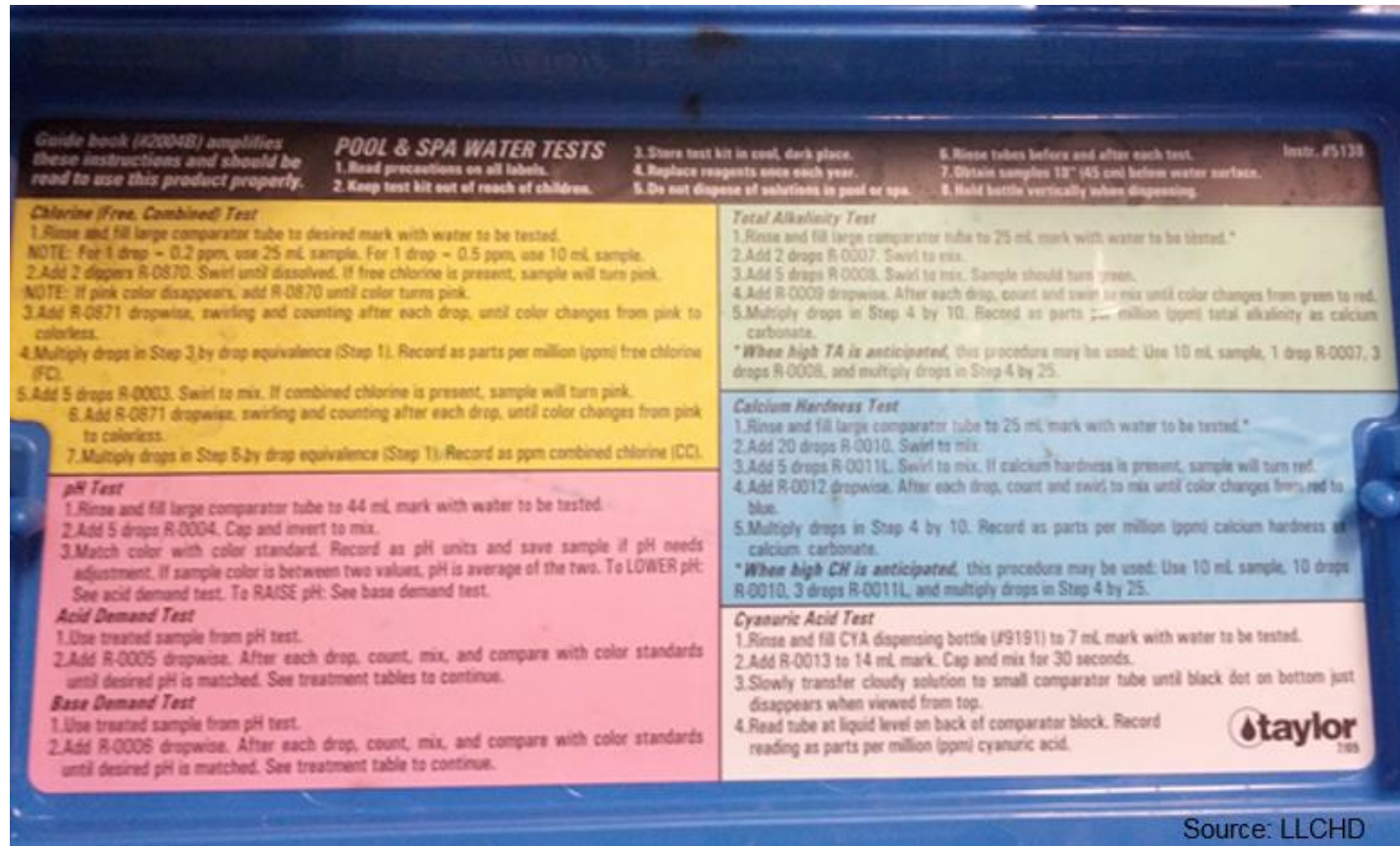
How To - Total Alkalinity (example from Taylor test kit*)

- Fill to 25 ml line
- Add 2 drops R-0007 thiosulfate N/10, swirl
- Add 5 drops R-0008 total alkalinity indicator, swirl
- Add drops of R-0009 sulfuric acid, count and swirl each drop until color changes from green to deep red
- Multiply drops by 10
 - Example: 15 drops X 10 = 150 ppm

* Other test kits available, follow kit instructions

Water Testing Methods

Instructions are in the lid of the test kit



Water Testing Methods

Results of Testing

Pool log is a 1 year record* of:

- Test results
- Chemistry adjustments
- Equipment maintenance
- Daily patron loads

Keep current copy of pool operator card and water tester certificate** on-site

* Douglas County requires keeping records 3 years

** LLCHD requirement



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Pool Closure

IF...

- Chlorine is not between 2 ppm–10 ppm
- Bromine is not between 2 ppm–18 ppm
- pH is not between 7.2–7.8
- Combined chlorine is above 0.5 ppm
- Cyanuric acid exceeds maximum 90 ppm
- Cannot see main drain
- **CLOSE THE POOL!!**



Spa Closure

IF...

- Chlorine is not between 3 ppm–10 ppm
- Bromine is not between 4 ppm–18 ppm
- pH is not between 7.2–7.8
- Combined chlorine is above 0.5 ppm
- Cyanuric acid exceeds maximum 90 ppm
- Cannot see main drain
- **CLOSE THE SPA!!**



Spas

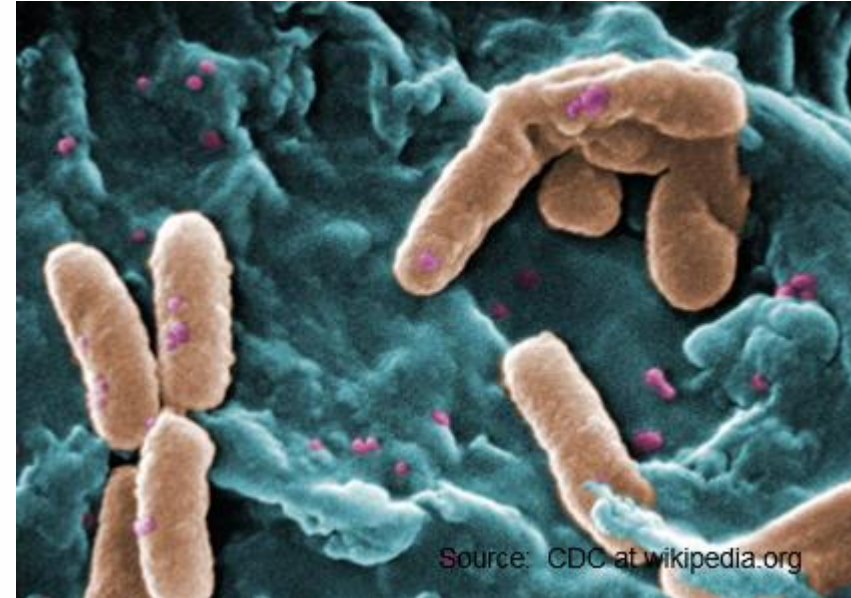
Spa problems

- Hyperthermia
- Entrapment
- Pseudomonas
- Dermatitis
- **Glass bottles!**



Spas

- Common spa “swimming” bacteria
 - *Pseudomonas aeruginosa*
 - Likes 98° F – 105 ° F water temperature
- Diseases caused by pseudomonas
 - Eye and ear infection
“swimmers ear”
 - Skin and respiratory infection
 - Endocarditis – infects heart valves
 - Urinary and gastrointestinal infection



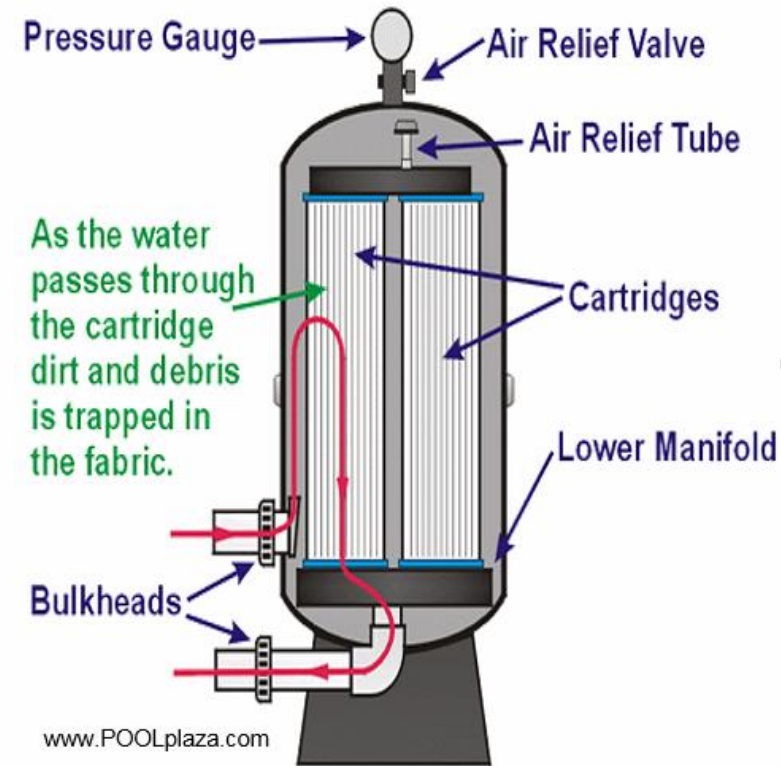
Spas

Recirculation of spa water

- 30 minutes turnover
 - Filtered
 - Sanitized
 - Heated
 - Returned to spa
-
- Air blower separate from water recirculation

Spas

- Water cleaned by cartridge or sand filter
 - 2nd cartridge is required



Spas

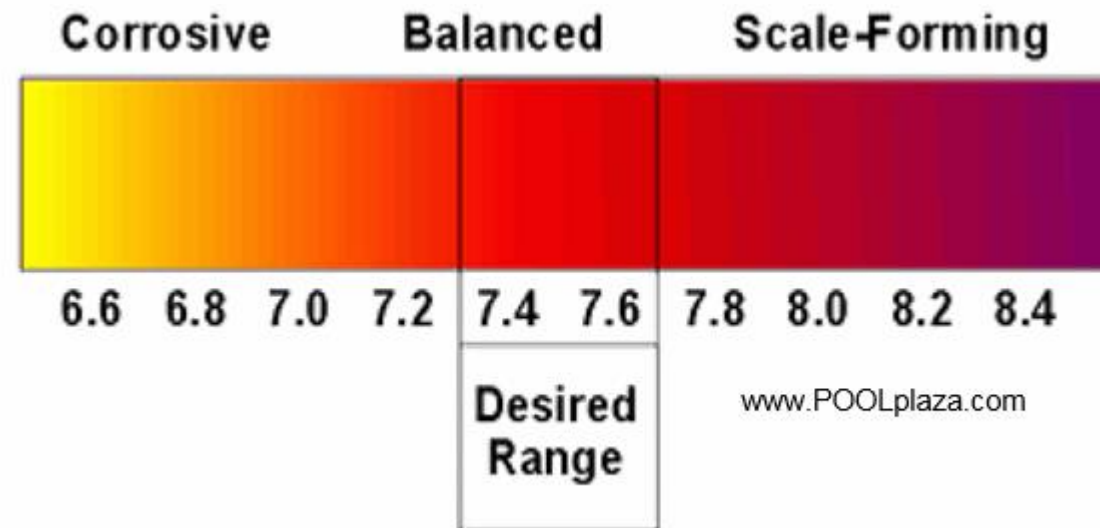
Water Chemistry Requirements

- **MINIMUM** 3.0 ppm free chlorine
- **MINIMUM** 4.0 ppm bromine
- pH 7.2 to 7.8
- Alkalinity above 80 ppm
- Temperature 98°F to 104°F



Spas

- Air and hot water can cause pH to rise thus lowering the ability of the disinfectant to kill bacteria



Spas

Spas are required to have:

- A timer for hydrotherapy pump and air blower
 - should be beyond arm's reach
- An emergency shut-off switch located near the spa in case entrapment should occur
 - Must shutdown entire spa system



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Spas

Spas are required to have:

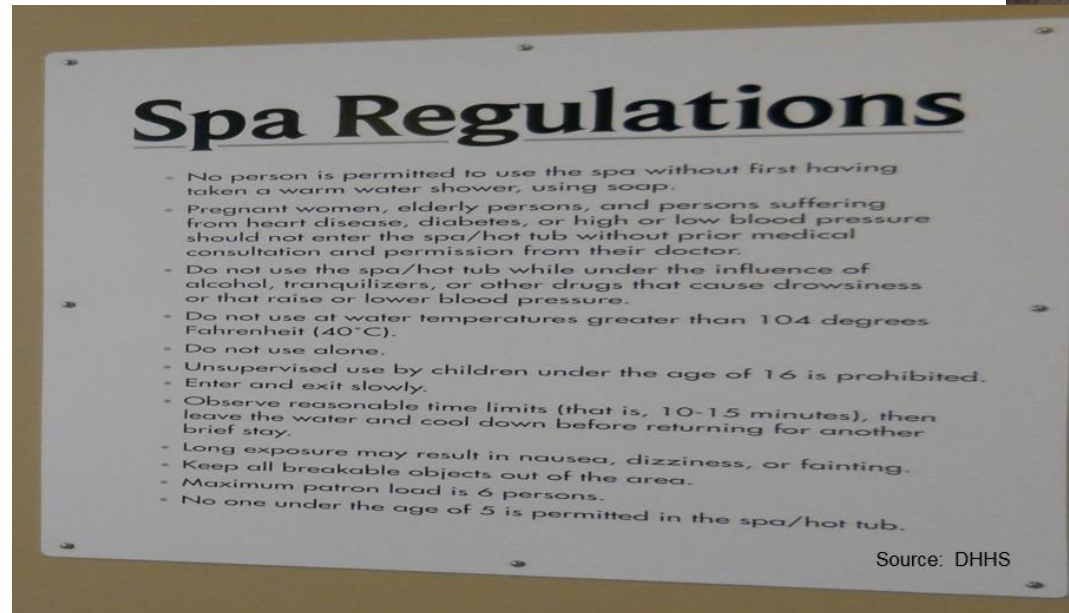
- A thermometer
 - Record temperature
 - Assure temperature does not exceed 104° F



Spas

Spas are required to have:

- Depth markers
- Signage



Rules & Regulations

- ALL pools must have ground fault circuit interrupts (GFCI) outlets



U.S. Consumer Product Safety Commission

All INDOOR pools are required to have a CO detector:

- If a gas heater is used
- In the pool area of an indoor pool
- In enclosed mechanical room for all pools



ClipArt

Swimming Pool Program

402-471-0903

<http://deq.ne.gov/NDEQProg.nsf/OnWeb/SP>



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